Energy Research and Development Division

FINAL PROJECT REPORT

Distributed Generation (DG) Screening Tool

A Pilot Tool for Economic and Environmental DG Planning

California Energy Commission

Edmund G. Brown Jr., Governor

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ABSTRACT

Site selection for solar energy generation equipment requires satisfying a variety of criteria, weighing challenges such as ease of permitting, interconnectivity to the electricity grid capability, and other considerations. To analyze these criteria, researchers developed a pilot tool that combines solar resource, environmental sensitivity, cost, and interconnection spatial data layers in a single geographic information system tool. The tool allows the user to input values for a variety of screening parameters that may be of interest to developers, local planners, and government officials; specifically, the tool contains input fields (for example text fields, buttons, and slider bars) that help users identify potential sites for distributed generation photovoltaics with low environmental impacts. The results show parcels matching the user-entered criteria, with details about the project attributes in both map-based and report formats. The tool is available at the following link: www.dg-solar.org.

Solar photovoltaic developers and local and environmental planners were targeted as the primary users for the tool, and the intended secondary users included utilities and county agencies. The pilot tool was designed for Lancaster, California (and unincorporated surrounding areas) because of its existing interest in solar development and availability of datasets; however, the tool can be implemented in other locations where comparable data is available and could be modified to focus attention on disadvantaged communities.

Keywords: Solar photovoltaics, solar, PV, distributed generation, DG, economic, cost, environment, environmental, screen, geographic information system, and GIS.

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PREFACE

The California Energy Commission's Energy Research and Development Division supports energy research and development programs to spur innovation in energy efficiency, renewable energy and advanced clean generation, energy-related environmental protection, energy transmission and distribution, and transportation.

In 2012, the Electric Program Investment Charge (EPIC) was established by the California Public Utilities Commission to fund public investments in research to create and advance new energy solutions, foster regional innovation, and bring ideas from the lab to the marketplace. The California Energy Commission and the state's three largest investor-owned utilities – Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Edison Company – were selected to administer the EPIC funds and advance novel technologies, tools, and strategies that provide benefits to their electric ratepayers.

The Energy Commission is committed to ensuring public participation in its research and development programs and reflects the rich and diverse characteristics of California, its people, and its innovative spirit. Guiding principles for these investments promotes greater reliability, lower costs, and increased safety for the California electric ratepayer and include:

- Providing societal benefits.
- Reducing greenhouse gas emission in the electricity sector at the lowest possible cost.
- Supporting California's loading order to meet energy needs first with energy efficiency and demand response, next with renewable energy (distributed generation and utility-scale), and finally with clean conventional electricity supply.
- Supporting low-emission vehicles and transportation.
- Providing economic development.
- Using ratepayer funds efficiently.

Distributed Generation (DG) Screening Tool is the final report for the Distributed Generation Environmental Planner project (grant number EPC-15-029) conducted by Black & Veatch. The information from this project contributes to Energy Research and Development Division's EPIC Program.

For more information about the Energy Research and Development Division, please visit the Energy Commission's website at www.energy.ca.gov/research/ or contact the Energy Commission at 916-327-1551.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Introduction

Governor Brown's Clean Energy Jobs Plan calls for adding 12,000 megawatts of distributed generation by 2020, focusing on small projects at or near the electricity end-user (e.g., rooftop solar). Achieving this goal requires resolving a complex, interrelated set of issues including better integration of land use and utility planning. State and federal agencies in collaboration with stakeholders are working to identify preferred areas for renewable energy development in California. Existing planning efforts in the desert regions of Southern California and San Joaquin Valley have focused on identifying preferred resource development areas suitable for energy generation (primarily utility-scale) that have low value for biological conservation. Statewide and regional tools such as the California Public Utilities Commission Renewable Portfolio Standard calculator and Renewable Energy Infrastructure Planning Assistant are being applied to support long-term planning and infrastructure decision making at the large-scale, system level. Until now, the planning resources had not been applied at the local (e.g., city or county) level to test how well information and tools can be adapted to inform local distributed generation planning and decision-making.

Project Purpose

Consistent information between planners, developers, and utilities is essential for promoting successful project siting, permitting, and interconnection of distributed solar photovoltaics. Aligning available datasets on a local scale will facilitate meeting distributed generation targets while supporting conservation and utility planning efforts in a manner that reduces the length of the permitting and interconnection process. Typically, environmental, cost, and interconnection information is available independently in multiple formats at varying spatial resolutions (e.g., parcels, grid cells). The Distributed Generation Screening Tool combines datasets into a single, streamlined, on-line geographic information application to offer transparency that will improve planning approaches used by distributed generation photovoltaic stakeholders. This project examined whether successfully demonstrated approaches for landscape scale energy planning could be adapted for use at a local scale for smaller renewable energy projects. The project was also intended to provide lessons learned for future enhancements of the tool, including for its use in other communities.

Project Process

The Distributed Generation Screening Tool was developed to integrate the relevant data with appropriate functionality to enable distributed generation photovoltaic planning and decision-making. Lancaster, California (and unincorporated surrounding areas) was selected as the site for the screening tool prototype due to the City's strong interest in solar development and the unmatched availability of data for the region. Most of the necessary data were already available so that the project could focus on designing, developing, and testing the tool rather than on data gathering. The scope of the pilot tool was limited to distributed solar photovoltaic systems. Five types of solar photovoltaic were considered the most commercially viable, distributed generation options for the Lancaster, California area: ground mounted (both tracking and fixed systems), commercial rooftop, parking lot canopy, and residential rooftop photovoltaic systems.

Early in the planning stage of the project, the team identified distributed solar photovoltaic developers and local and environmental planners as the primary audiences for the application.

Secondary audiences, such as utilities and county agencies, were also identified at the project onset. Representatives of these audience groups from the Lancaster area helped drive design decisions throughout development of the tool.

The team developed and maintained a technical specification (hereafter "tech spec") during the Distributed Generation Screening Tool development process. This tech spec defined the major attributes of the tool including data, screening criteria, user inputs, functionality, and desired outputs. The final version of the tech spec served as the tool design standard that was used in preparing the beta version of the tool for testing purposes.

After the initial development, the project team conducted an extensive beta testing phase to review the functionality and design of the tool. Representatives of the intended audiences reviewed the tool and provided final input. After finalizing the tool, the team conducted a case study to demonstrate and evaluate the tool's overall functionality.

Project Results

Based on the tech spec, the team compiled and processed the relevant data and coded the tool as a web-based platform; the tool is publicly available at www.dg-solar.org. The integrated user screen includes energy, environmental, and cost input.

The case study conducted to showcase the functionality of the tool provided numerous individual project and portfolio results including the number, capacity, and location of potential projects matching the selected criteria and sensitivities. Throughout the pilot tool development, the project team evaluated the data availability and programming capability that could be used to achieve desired tool functionality. The project demonstrated that landscape scale energy and conservation planning tools could be effectively adapted to smaller scale, distributed generation planning that also minimizes environmental impacts.

The Distributed Generation Screening Tool can be easily updated to advance the benefits of clean energy in low-income and disadvantaged communities, to incorporate newly available datasets, to incorporate additional automation, and to expand geographic coverage.

Benefits to California

Because the tool shows where projects can be economical in areas of low environmental impact, the Distributed Generation Screening Tool may have environmental and cost benefits if used for local and distributed energy planning purposes. Developers may use the tool to avoid areas with known environmental impacts from the outset of their projects, reducing the potential for habitat disturbance and permitting delays. Furthermore, by combining available information into a single application, project planning steps may be streamlined, reducing permitting uncertainty and development costs. As with similar landscape scale planning tools, this screening tool facilitates communication among stakeholders by providing multiple views into a shared set of vetted data. Although the pilot tool is limited to a single geographic area, it could be adapted to other communities across the state if the appropriate data is available.

CHAPTER 1: Introduction

Project Introduction

Background

Governor Brown's Clean Energy Jobs Plan calls for adding 12,000 megawatts (MW) of Distributed Generation (DG) by 2020 (Brown, 2010). It generally defines DG as projects sized 20 MW or less, interconnected on-site or close to load, that can be constructed quickly with no new transmission lines, and, typically, without any significant environmental impact. Achieving this goal will require resolving a complex, interrelated set of issues including better integration of land use and utility planning. New spatial decision support tools may help energy developers select project sites with lower environmental impact and/or help local agencies expedite their permit reviews.

State and federal agencies in collaboration with stakeholders are working to identify preferred areas for renewable energy development in California. The Desert Renewable Energy Conservation Plan (DRECP) process identified Development Focus Areas that are considered suitable for energy generation (primarily utility-scale) while having low value for biological conservation (California Energy Commission, 2010-2017). The San Joaquin Valley Solar Study intended to identify areas of least conflict with environmental and agricultural values that are appropriate for solar development in this region (Pearce et al., 2016). The California Public Utilities Commission (CPUC) created the Renewable Portfolio Standard (RPS) Calculator to develop plausible economic scenarios for use in long-term planning (California Public Utilities Commission, 2016). The California Energy Commission (Energy Commission) funded development of a decision support tool for regional to statewide scale planning of utility-scale renewable energy, called the Renewable Energy Infrastructure Planning Assistant (REIPA)[1]. Produced by the Conservation Biology Institute (CBI), the REIPA is being used for regional/state planning exercises. Until now, the REIPA had not yet been applied at the local (e.g., county) level for DG planning to test how well that tool and data sets can be adapted to planning/decision making.

Project developers, local planners, utilities, landowners and other stakeholders must be able to access environmental information in an organized, central location to support informed and cost-effective project siting and permitting of distributed solar photovoltaics (PV). Relevant environmental information includes data on the relative conservation value of sites for plants and animals. This project has combined the spatial information, factors, and analytical tools developed for regional PV cost and environmental planning and applied the data effectively for a case study of a local DG planning area.

Project Overview

Black & Veatch partnered with Conservation Biology Institute (CBI) to create a tool that builds upon and improves current local level planning and permitting tools for DG PV facilities; the

[1] Conservation Biology Institute, 2016

aforementioned tool will expedite meeting DG goals while minimizing impacts to environmentally sensitive areas and keeping energy costs low. The project team developed a web-based DG Screening Tool that joins geospatial data on solar resource, land environmental sensitivity, capital cost, and local utility distribution infrastructure to examine DG PV potential. The pilot tool focuses on Lancaster, California, and can ultimately be applied anywhere there is enough granular data available.

The DG Screening Tool allows users to select inputs that define project search criteria in key areas (plant type, interconnection, environmental impacts and cost) and identifies resulting land parcels in Lancaster that satisfy the user requirements.

Project Goals & Objectives

Project Goals

Incorporating environmental data in a geospatial format has been instrumental to state-wide utility-scale generation planning processes (such as the DRECP and RPS Calculator) to align local, state and federal renewable energy development, conservation plans, transmission plans, policies and goals. Similar alignment on a local scale will facilitate meeting distributed generation targets, while supporting conservation and utility planning efforts in a manner that reduces permitting and interconnection process duration.

Consistent information between planners, developers, and utilities is essential for ensuring successful project siting, permitting, and interconnection of distributed solar PV. However, environmental information is not widely available, particularly for DG PV, and environmental, engineering, cost, and electrical distribution data are usually disparate. The advantage of combining datasets in a single application targeted to DG is to leverage existing efforts and offer transparency that will improve planning approaches used by DG PV stakeholders.

The main project goals are:

- Enable decision-making about siting DG PV development by policymakers, stakeholders and planners based on a combination of environmental and engineering spatial data.
- Reduce uncertainty of environmental permitting by improving availability and interpretation of geospatial data.
- Reduce project cost and permitting risk, and in doing so, support market function by making the same information available to everyone (e.g. developers, agencies and customers) leading to more economic projects with fewer anticipated roadblocks.

Project Objectives

Following the goals established the project objectives are:

- Provide a transparent, analytically rigorous, publically available tool that enables renewable DG PV site selection in environmentally preferred locations.
- Apply the tool in a case study for a specific local area (e.g., Lancaster, California) to demonstrate and evaluate the online tool functionality.
- Support and facilitate communication among stakeholders (project developers, landowners, policymakers, and utilities).
- Document the lessons learned so that the tool can be effectively applied to other areas in California and the nation.

CHAPTER 2: Scope of Design

Public Tools and Datasets

Existing Resources

A number of public resources have been developed in support of renewable development. In order to leverage prior investments in tools related to renewable development decision-making, the project team organized a list of existing applications in Table 1.

Table 1: Existing Renewable Planning Tools

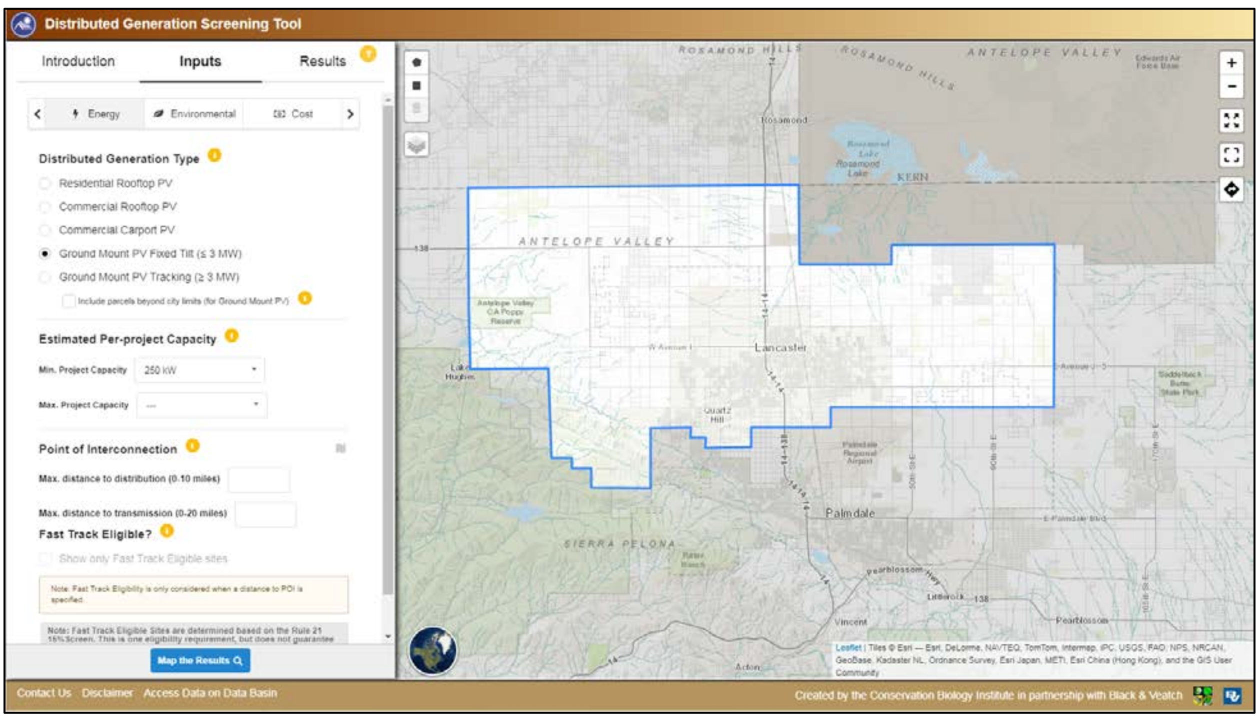
Dataset Title	Description	Access
Berkeley Lab Distributed Energy Resources Customer Adoption Model (DER-CAM)	Economic model of customer DER adoption. The DER-CAM model chooses which DG and/or CHP technologies a customer should adopt and how that technology should be operated.	https://building-microgrid.lbl.gov/projects/der-cam
CBI RE Infrastructure Planning Assistant	Supports DRECP effort to provide effective protection and conservation of desert ecosystems and the appropriate development of renewable energy projects.	http://drecp.consbio.webfactional.com/energy
Google Project SunRoof	Uses Google Earth imagery to analyze rooftop solar potential, provide savings and connect users to providers.	google.com/get/sunroof
Los Angeles (LA) County Solar Map	High-resolution rooftop solar analysis for LA County; provides savings and connects users to solar providers.	http//solarmap.lacounty.gov/
National Renewable Energy Laboratory (NREL) PVWatts Model and System Advisor Model (SAM)	PVWatts estimates energy production and cost of energy for connected PV systems. SAM is a performance and financial model designed to facilitate systems-based analysis of solar and other technologies to support project-level prefeasibility decision making.	pvwatts.nrel.gov/ https://sam.nrel.gov/
CPUC Renewable Portfolio Standard (RPS) Calculator	Model creates plausible portfolios of renewable resources needed to meet RPS policy goals. Includes detailed renewable project resource models and plausible transmission upgrades to serve California Independent System Operator loads.	http://www.cpuc.ca.gov/RPS_Calculator/
San Francisco Department of Environment Solar Resilient	Estimates size of grid-connected PV and storage to provide power at a site during an outage.	solarresilient.org/

Distinguishing the DG Screening Tool

Publically available tools focused on environmental impacts of renewable development have historically focused on utility size project development that will cover many acres of land without sufficient spatial resolution, or granularity, at the DG level. Often DG information is not widely available or accessible to project developers, local planners, utilities, landowners, and other stakeholders in an organized, centralized location. Furthermore, existing online applications targeted toward distributed development tend to focus on project finance and available resources for individual customers and property owners but do not integrate environmental and interconnection considerations that may be used for planning purposes.

The DG Screening Tool was developed to integrate the spectrum of relevant project information in a widely accessible manner, with functionality to enable planning and decision-making. The scope of the pilot tool was limited to distributed solar PV including ground mount systems (tracking and fixed systems), commercial rooftops, parking lots, and residential PV systems. The integrated user screen including energy, environmental, and cost inputs is shown in Figure . The tool is publicly available (www.DG-Solar.org),[2] with input fields (text fields, buttons and slider bars) that will enable easy scenario and what-if analysis for identifying sites for DG PV with low environmental impacts.

Figure 1: DG Screening Tool Integrated "Inputs" Page



Intended Audience and Use Cases

The intended audience helped drive design decisions throughout development of the tool. Early in the planning stage of the project, the team identified distributed solar PV developers and

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[2] It is best to use Google Chrome or Mozilla Firefox with the tool; some features do not work with Internet Explorer.

local and environmental planners as the primary audiences for the application. Secondary audiences such as utilities and county agencies were also identified at the project onset.

The four use cases centered around one of two possibilities: 1) a developer, planner, or government that is interested in examining multiple sites or a large area simultaneously, or 2) a developer or property owner that is interested in a particular plot of land (one or more parcels). Specific use cases were considered for each project owner, which was used to define the overall user experience; more details are explored below.

Developers (Third Party, Government/ Non-profit, Property Owner)

Developers of distributed solar PV generation were identified as primary users for the tool for application in the initial site selection, which is a critical and initial stage of the development process. Solar site selection requires optimization across a variety of criteria, weighing challenges such as ease of permitting against difficulty for interconnection along with many other considerations. The format of the tool allows user-entered selection for a variety of screening parameters that may be of interest to developers.

Building in multiple ownership structures expanded the definition of PV developer in the tool to include such entities as third party developers, government or municipal agencies interested in community solar, and individual residential or commercial property owners. Users with a preferred development location, such as a single building or selected parcel, were also considered and address search functionality was included to allow reporting for a single project site.

Local and Environmental Planners

Granular datasets covering environmental and conservation information relevant to the environmental impact of DG have become more available in recent years. By bringing this information into a centralized tool and incorporating CBI efforts to synthesize the data into decision-support metrics, local and environmental planners can apply the information to implement new project environmental screening methods.

The tool was designed to demonstrate a platform that could be used to support environmental screening based on priority maps. Environmental and conservation priority maps were selected from previous environmental decision work conducted by CBI in the Lancaster area using their Environmental Evaluation and Modeling System (EEMS).[3] Slider bars allow users to adjust various environmental constraints to determine which projects satisfy the user-entered criteria. By aligning the decision-support metrics in the tool with environmental screening requirements, environmental planners may use the tool to quickly identify conservation values and whether a specific project is in need of a more detailed review.

New environmental review procedures require changes to the regulatory process to implement; however, local and environmental planners may use this pilot tool and the presented datasets to examine how such a tool may streamline reviews for smaller DG projects in the future.

Other Users

In addition to uses in environmental permit screening, regulatory groups in the Lancaster Area may wish to apply the tool as a central environmental planning platform to determine the

3 Website: https://consbio.org/products/tools/environmental-evaluation-modeling-system-eems

consequences of various environmental and zoning requirements in the context of DG targets and available resource potential.

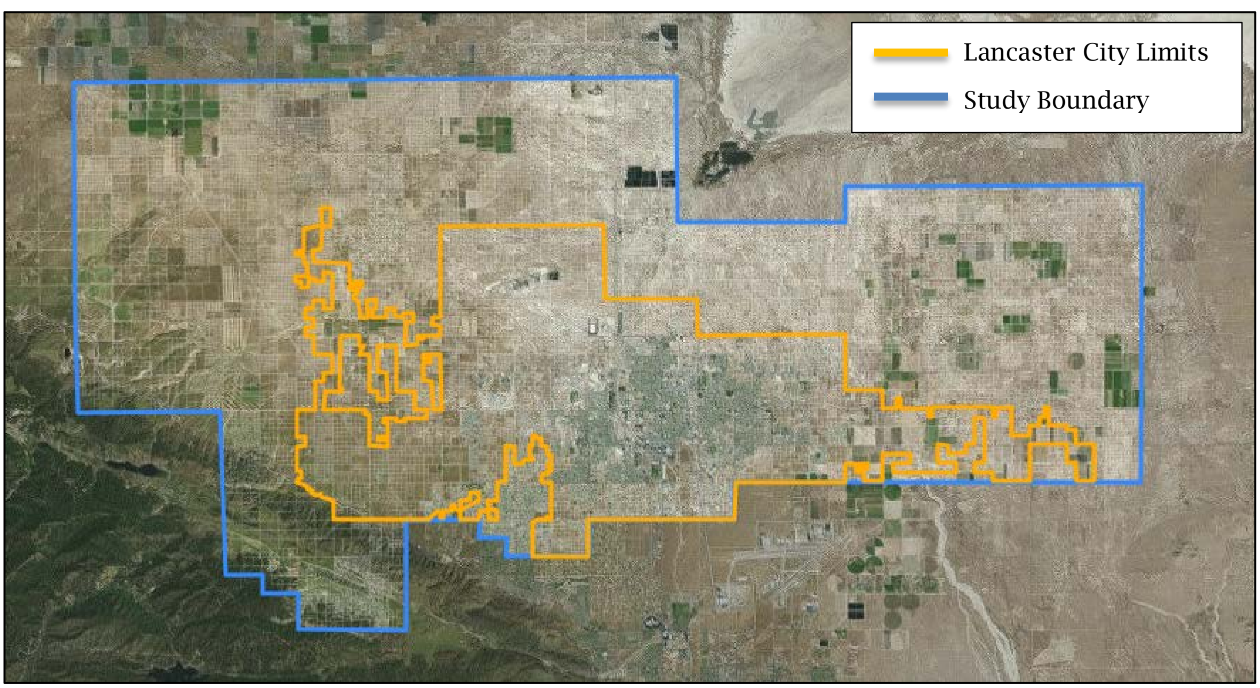
Choice of Lancaster, California, for Pilot Implementation

Existing solar development interest and availability of datasets led to selecting Lancaster, California (and unincorporated surrounding areas) to be used for demonstrating the pilot tool. The Lancaster, California, area has an excellent solar resource and large availability of flat, developable, land, which has made the area a target of development for both large distributed and utility-scale solar PV projects. As part of Los Angeles (LA) County, the region was included in a detailed rooftop PV potential study conducted in 2012 that produced a rich geospatial solar resource dataset for the region. The area was also included in the detailed environmental analyses and datasets developed under the DRECP. Thus, key geospatial datasets with detailed granularity were available.

The City of Lancaster has also adopted aggressive sustainability targets that have attracted large amounts of distributed PV development. As of 2014, all new residential buildings in the city are required to have a PV system installed or to purchase an equivalent amount of solar renewable energy credits from another solar installation in the city. According to a press release, Lancaster also partnered with SolarCity to create the “Solar Lancaster” program to encourage businesses to also consider solar. The Solar Lancaster Program has deployed more than 20 MW of solar power (SolarCity, 2015).

A screenshot of the study region in the DG Screening Tool is shown in Figure 1; the city limits are shown in the orange and the surrounding unincorporated area that define the pilot tool boundaries are in blue. The blue line was selected to include areas where ground mount solar was available outside the populated areas of the city boundaries but close enough to serve the city without interconnection to the transmission grid.

Figure 1: Selected Pilot Tool Boundaries for the City of Lancaster and Surrounding Area



CHAPTER 3: Tool Design Implementation

Technical Specification Summary

Purpose

A technical specification ("tech spec") was developed and maintained during the development process of the DG Screening Tool to define the following major attributes of the tool:

- Data inputs,
- Screening criteria,
- User inputs,
- Functionality,
- Results, and
- Reporting.

A subset of critical information from the tech spec was reviewed by the Technical Advisory Committee during a workshop and subsequent comment period. The final version of the tech spec served as the tool design standard that was used in preparation of the beta version of the tool. The full tech spec is included in Appendix A and contains detailed design information. The following section highlights the major attributes and functionality of the DG Screening Tool.

Datasets

There are four main categories of datasets that were included for the DG Screening Tool; specifically, the datasets include: (1) solar PV resource datasets, (2) solar PV cost datasets, (3) land and environmental exclusion data, and (4) transmission and distribution data. More details about the datasets are provided in Appendix A.

Solar PV Resource Datasets

Solar PV Type

As part of the screening application, for each Solar PV type, the user can select a range of pre-determined, standard project capacity sizes to include in the screen. Independent resource datasets were gathered based on Solar PV type (e.g., rooftop, parking lot and ground mount).

Rooftop Solar Performance

Rooftop solar performance data was based on the Los Angeles (LA) County Solar Map developed from Light Detection and Ranging (LiDAR) data. This dataset contains project sizes calculated for each residential and commercial rooftop in LA County and a standard capacity factor.

Parking Lot Potential

To identify parking lot potential in the city, Black & Veatch's aerial imagery analysis was performed for Lancaster. United States Geological Survey (USGS) orthoimagery was retrieved from the USGS Earth Explorer site and geographic information system (GIS) analysis was used to identify the parking lots.

Ground Mount Solar PV Capacity

To determine the available ground mount solar PV capacity available on each parcel, a MW/acre conversion factor was selected for fixed tilt and tracking systems. Project assumptions on mounting structure were characterized by project size, where projects >3 MW were considered tracking systems and ≤3 MW were considered fixed tilt. Given the relatively small size and consistent resource of the pilot area, a single average capacity factor for the city was used for tracking and fixed tilt systems.

Solar PV Cost Data

Levelized Cost of Energy (LCOE) values were calculated by Black & Veatch for each DG type based on typical industry capital cost, standard user and system types. Standard financing assumptions were defined for each user type based on typical industry values. Project sizes were selected to be representative of natural breakpoints in project capital costs and technology considerations (e.g. fixed vs. tracking).

Land and Environmental Data

A number of land and environmental datasets were used for the development of this tool.

Protected Areas (Environmental Exclusions)

This layer displays the September 2016 Gap Analysis Program (GAP) Status Codes of protected areas for the Antelope Valley and West Mojave Ecoregion, which includes Lancaster, CA. GAP Status Codes describe the degree to which land is managed for conservation. Land in Codes 1 and 2 have the highest degree of conservation management, while status 3 lands support multiple uses, including resource extraction (forestry, mining, etc.).

Wetlands

The wetlands layer is from the National Wetlands Inventory of the US Fish and Wildlife Service. It includes the following categories of wetlands: freshwater emergent wetlands, freshwater forested/shrub wetlands, freshwater ponds, lakes and riverine areas.

Focal Species

Twenty-three focal species including a variety of plants and wildlife were selected consulting experts. The likelihood of a species being found in a particular parcel is estimated through standard Species Distribution models. A model to estimate species presence of the selected focal species was run by CBI at grid cell resolution of 270 m per side.

Conservation Value

Conservation values for a parcel is modeled based on various animal and plant conservation attributes. This dataset was created by CBI using a logic model in the EEMS. It displays an index of biological conservation attributes at grid cell resolution of 270 m per side across the entire West Mojave area that includes the Lancaster area.

Level of Development

This dataset provides an estimate of landscape intactness (i.e., condition) based on the extent to which human impacts (i.e., urban development, natural resource extraction, and agriculture) have disrupted the natural landscape across the study site. Terrestrial intactness values are rated as high in areas where human impacts to the natural landscape are minimal (i.e. the natural habitat is highly intact). This index was also created by CBI using a logic model in the EEMS.

Wildlife Linkage

Wildlife linkage priority areas map the least resistant paths for wildlife movement across the landscape (i.e., is easiest for wildlife to move through). It is based on a complex model by CBI that incorporates the relative density of roads, buildings, vegetation, and other factors potentially influencing animal movement.

Transmission and Distribution Data

Southern California Edison (SCE) is the electric utility serving Lancaster. SCE has made certain elements of their transmission and distribution facility data publicly available for download via their Distributed Energy Resource Interconnection Map (DERiM) website. The DERiM contains locations of transmission and distribution facilities as well as feeder (and sub feeder) specific data. Project locations eligible for "Fast Track" screening under the California Rule 21 generation tariff are also identified in DERiM. Fast Track eligible projects enter a streamlined interconnection process where review timelines are reduced from 6-12 months to weeks.

Supplemental Information on Datasets

This screening tool uses parcel and zoning data from the LA County GIS Data Portal, updated in 2010. City zoning data was provided in GIS format by the City of Lancaster. Key datasets are summarized in Table 2, which provides additional detail on the year and resolution of each dataset.

Table 2: Selected Datasets Incorporated in the DG Screening Tool

Data	DG Type	Information	Year	Granularity
LA County Solar Map	Rooftop PV (C&I Residential)	Solar System Size & Performance	2006, updated in 2017	Parcel
Aerial Imagery (Black & Veatch Analysis)	C&I Parking Lot	Solar System Size	2016	Parcel
CPUC RPS Calculator	Ground Mount PV	Solar System Size & Performance	Updated 2016	City
CBI RE Infrastructure Planning Assistant	Ground Mount	Exclusions, Wetlands, Development, Conservation Value, Landscape Intactness, Wildlife Linkages, and Focal Species	Updated 2016	Parcel, 270 m, 1 km^2
SCE DERiM/ICA Maps	All PV	Transmission & Distribution Facility Location and Fast Track Availability	2016	Sub Feeder
Black & Veatch Solar Cost	All PV	LCOE Values	2016	90 Standard Values

City Zoning Map	All PV	Lancaster Parcel Zoning	Latest	Parcel
Parcel Data	All PV	2010 LA County GIS Data Portal	2010	Parcel

Original data was gathered in a variety of formats including: Microsoft Database, online GIS data layers (hosted in Data Basin and ArcGIS Web Map), GIS shapefiles, and Excel data tables. The data were converted into a geospatial format as needed. Information that was not already in a geospatial format included spatial identifiers, such as an address or latitude and longitude, to allow mapping data to individual parcels.

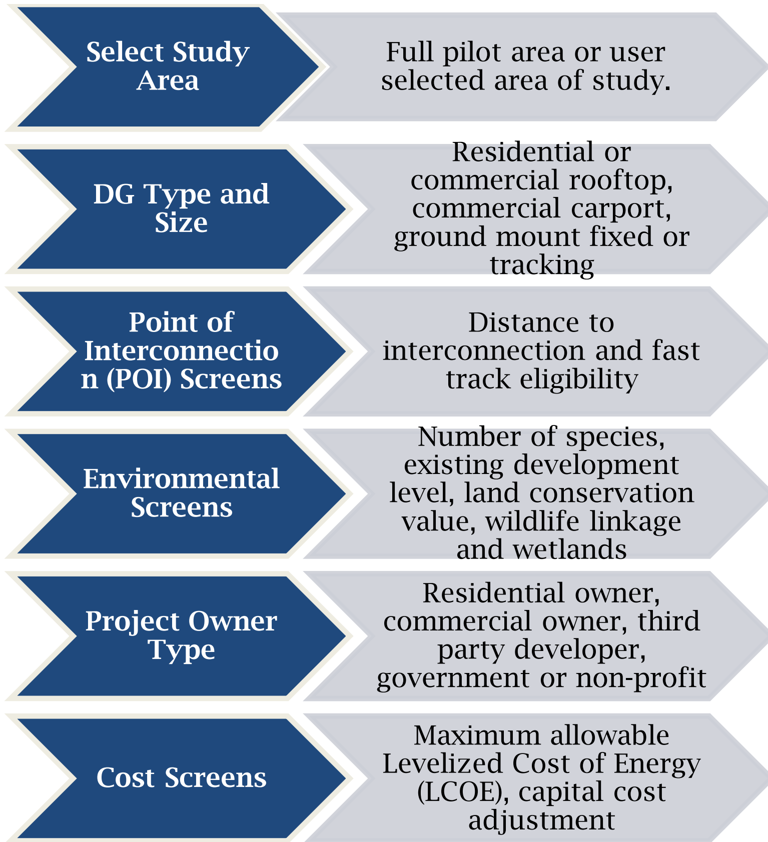
All data in the tool was obtained from publically available sources, with exception of two Black & Veatch data sets: 1) solar cost data and 2) commercial and industrial parking lot size data. All public datasets have been made available for download from the CBI Data Basin platform with additional documentation provided in the "Help" document in the tool.

Screening Functionality

The DG Screening tool consists of a user-defined search area and input tabs that are used to define and refine the DG system design, environmental considerations and project costs. The tool is designed to allow users to follow a logical progression from one tab to the next to set the screening thresholds used to determine the parcels satisfying the user's specified criteria. A list of user inputs is shown in

Figure 2, which also depicts the flow of tabs navigated by the user within the tool.

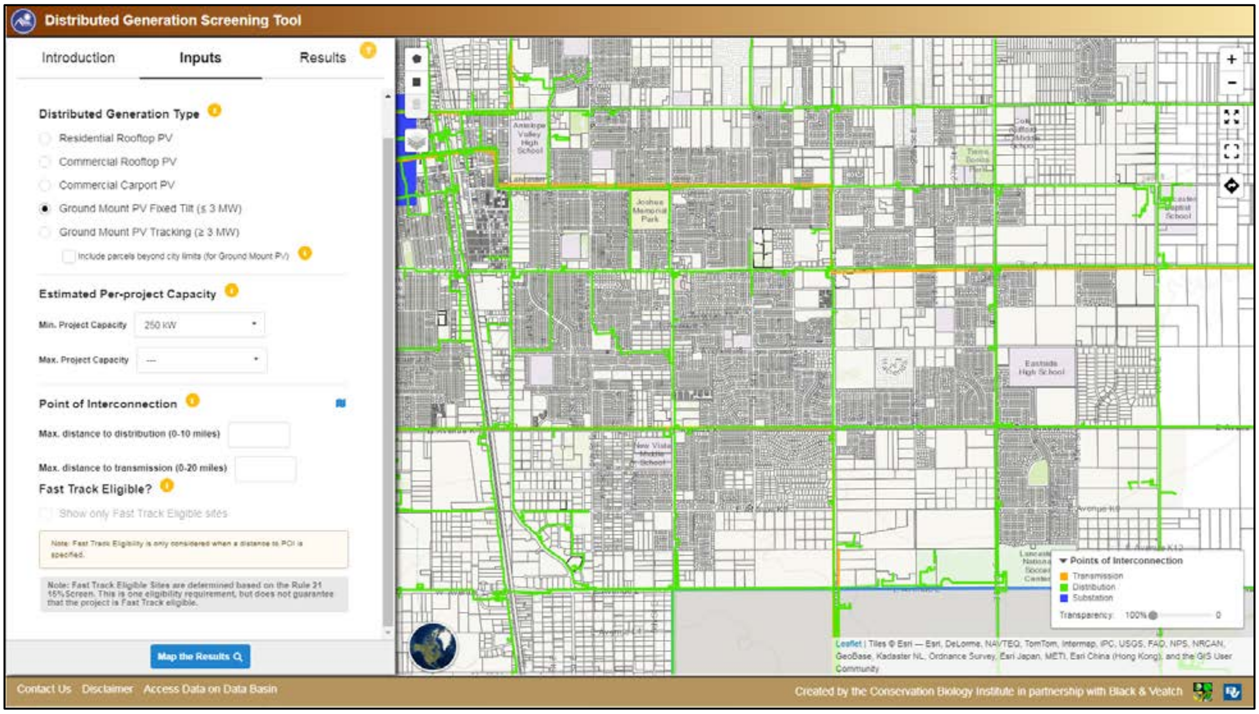
Figure 2: List of DG Screening Tool Inputs



Based on selected inputs, downstream inputs and tabs in the current and remaining tabs will be adjusted according to the logic applicable to that particular selection. For example, point of interconnection (POI) is not relevant for residential rooftop projects because there will only be one POI; thus, the POI section disappears if a residential rooftop is selected. This functionality is designed to limit possible user inputs to realistic options.

First, the user selects a DG type and, if desired, a minimum and maximum project size. Relevant interconnection options will appear based on the user's selection. A screenshot of the energy input tab is shown in Figure 3, the DG selection and interconnection inputs (distance to POI and fast track eligibility) are on the left while a map is on the right. In this example, a layer showing the utility's distribution facilities (i.e., POI) is displayed.

Figure 3: Energy Input Tab while Displaying Distribution Facilities



On the next tab, environmental screens are defined when applicable. If a ground mounted DG PV type is not selected the tab will turn grey and not be clickable since environmental screens are not relevant. The environmental screens include two types of selections—exclusions that block selection of parcels for solar development and lands with conservation features that might make permitting more difficult and expensive. The exclusions, which are checked either on or off, include:

- **Protected Areas Exclusion**: eliminates protected areas of National GAP status 1-3 (U.S. Geological Survey, 2015) and military lands that fall within the tool boundary. [4]

- **Wetland Areas Exclusion**: eliminates rivers, streams, lakes, ponds and areas where the water table is higher than the soil surface.

The second type of environmental screen is built with sliders that allow the user to select the desired threshold value. Following is a description of each screen:

- **Number of Focal Species**: screens based on the maximum number of focal species that would be acceptable on candidate parcels. The user can also identify individual species that must be excluded in the screening process.

- **Level of Development**: displays parcel-wide percent of area with buildings, roads, and other infrastructure. The screens range from very low to very high development levels, allowing users to exclude parcels from solar development that are not heavily developed at present.

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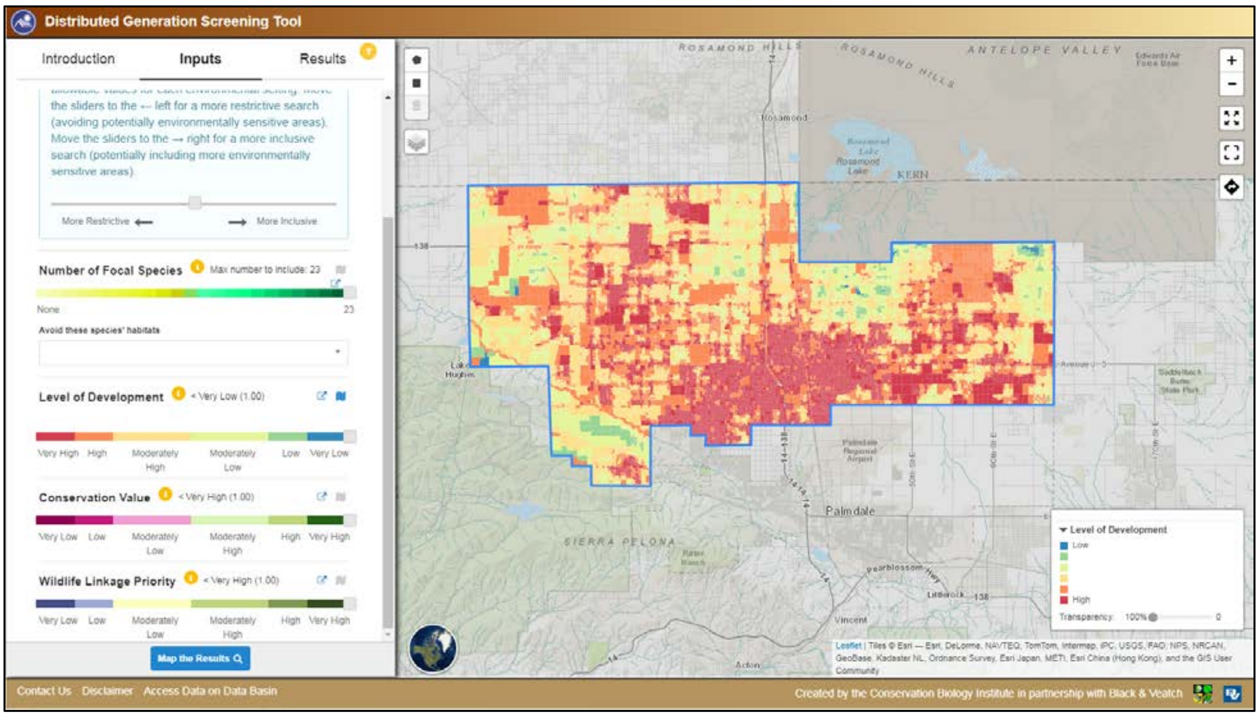
[4] The GAP status levels are defined at https://gapanalysis.usgs.gov/padus/protected-areas-stats/

- **Conservation Value**: combines animal and plant conservation attributes for any given area. The screens range from very high to very low conservation value areas.
- **Wildlife Linkage Priority:** displays the least resistant paths for wildlife movement across the landscape (i.e., is easiest for wildlife to move through).

The environmental tab implementation is shown in Figure 4; the sliders on the left allow users to adjust each environmental screen. On the right, a map of the selected area is visible, and the user can show layers of interest. The Level of Development layer is shown; the key in the bottom right of the figure illustrates that the blue and yellow areas represent regions with low to medium levels of development, and the red areas represent areas of high existing development. The transparency of the layer can be increased in order to show multiple environmental data sets simultaneously (although more than two is difficult to distinguish).

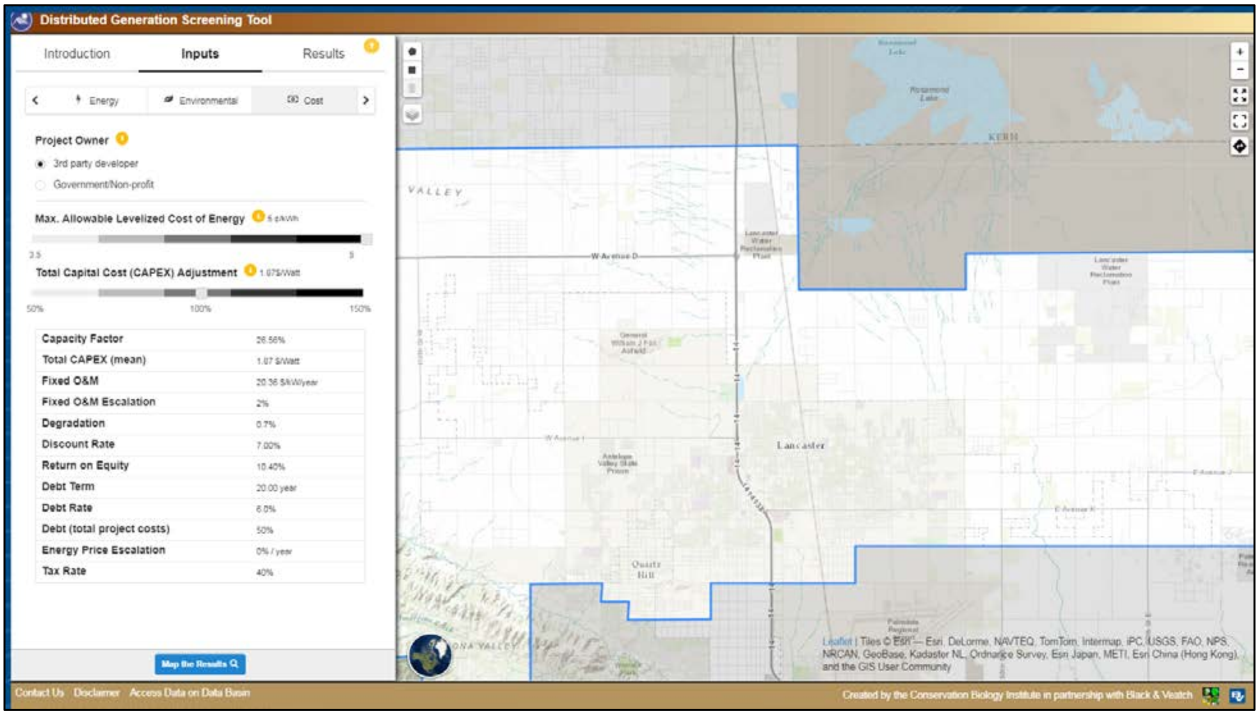
Figure 4: Environmental Input Tab, While Displaying Level of Development



The last input tab is for the cost parameters. The user may select between multiple types of project ownership relevant for each project type (those not relevant do not appear). The ownership type adjusts the financing assumptions and federal tax incentives (if any) that are used for the LCOE calculation. Further, the following four ownership structures can be selected: third party developers, commercial property owners, residential property owners, and government/non-profit agencies. LCOE values were pre-calculated for each DG type based on the selected owner and PV system combinations.

Also, the Cost Input Tab provides the option to adjust the capital cost on a percentage basis relative to the baseline values. This feature allows the tool to remain relevant in the midst of rapidly decreasing equipment costs or in the circumstance there are higher costs due to unique considerations (e.g., mountainous terrain). Finally, a maximum allowable LCOE can be selected which will eliminate projects more costly than this value from the final results. These selections are made by the user on the cost tab of the input section of the tool and are shown on the left hand side of Figure 5.

Figure 5: Cost Input Tab

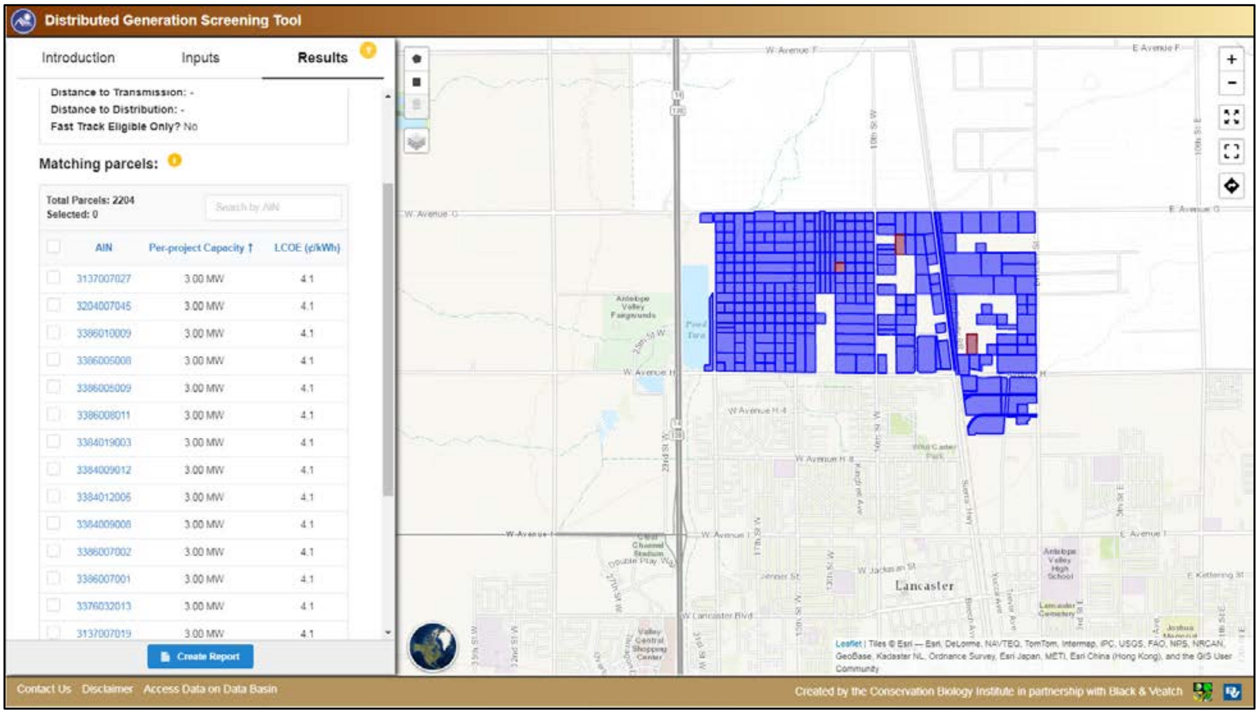


At any point in the screening process, prior to clicking the **Map the Results** button, the user can also limit the selection to a smaller geographic area. This can be done with either the polygon or rectangle drawing tool in the upper left corner of the map window. This allows the user to focus on a particular area of interest or to limit the number of parcels selected when system limitations would be exceeded.

Reporting Functionality

At any point, on any of the input screens, the user may click the **Map the Results** button. The analysis will use default values for any of the tabs or inputs that users have not updated. On the results screen, users will find parcels that satisfy the selected screens displayed as a list and on the map as demonstrated in Figure 6. A list of eligible parcels identified by the Assessor's Identification Number (AIN) will be displayed on the left. By default, the list will be ordered from top to bottom in terms of per project capacity from largest to smallest. The user, however, has the option to sort the list by LCOE, project capacity, or AIN number in either ascending or descending order.

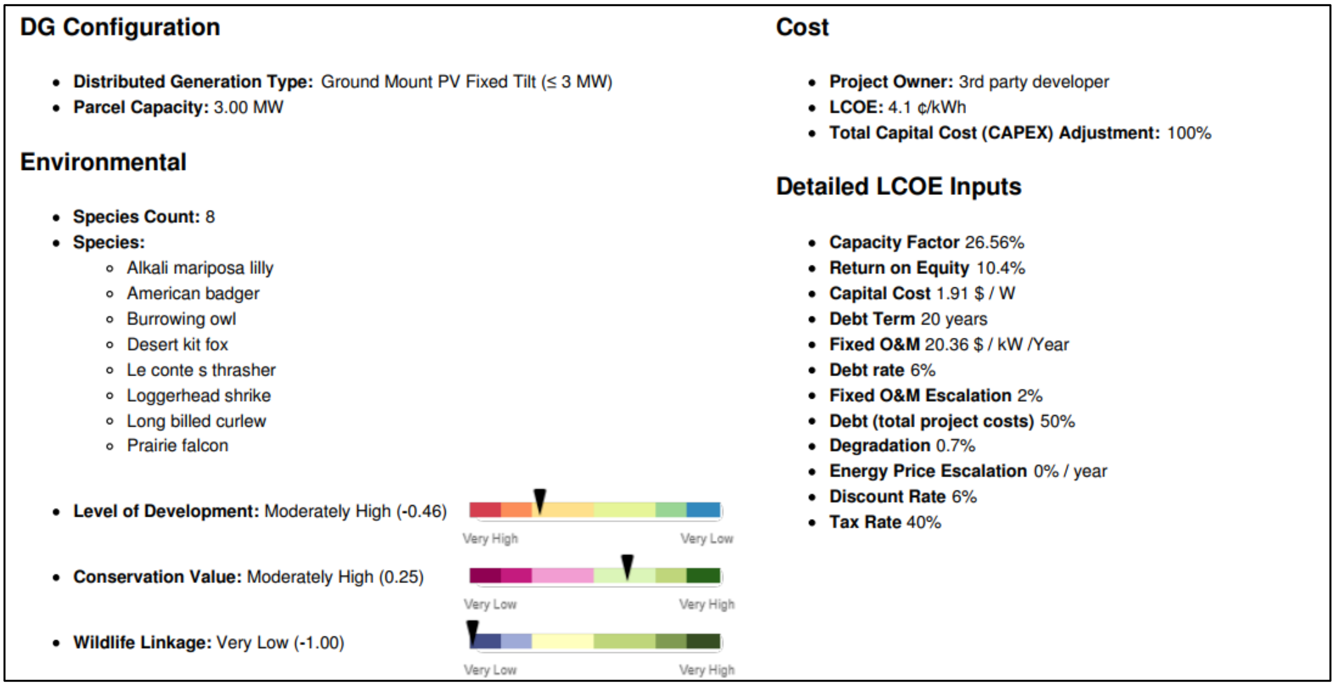
Figure 6: Results Tab



There are several ways to highlight specific parcels. Selecting a single parcel from the list of parcels will display the parcel in red on the map and the AIN number will be highlighted (not shown). Multiple parcels can be selected simultaneously. Another way to highlight a parcel on the map is for the user to hover over the AIN in the list. The user can also choose to export results for a single parcel or a portfolio of selected parcels to a PDF file using the **Create Report** button. The user must select one or more parcels from the list on the left before clicking the **Create Report** button; otherwise, the user will encounter an error. Parcels can be selected individually using the check boxes for each line, next to each AIN number, or the user can select the full set all parcels that pass the screen by clicking the box next to the **AIN** header at the top of the list.

The report generated by the **Create Report** button provides a document with detailed information for that project(s). Figure 7 illustrates an example report for a project including an individual parcel. The information in the report includes the user-selected and default inputs, a visual representation of the environmental selections, detailed cost assumptions, and interconnection information. A detailed map of the parcel is also included on the report (not shown).

Figure 7: Individual Parcel Report



DG Configuration

- **Distributed Generation Type:** Ground Mount PV Fixed Tilt (≤ 3 MW)
- **Parcel Capacity:** 3.00 MW

Environmental

- **Species Count:** 8
- **Species:**
  - Alkali mariposa lilly
  - American badger
  - Burrowing owl
  - Desert kit fox
  - Le conte s thrasher
  - Loggerhead shrike
  - Long billed curlew
  - Prairie falcon
- **Level of Development:** Moderately High (-0.46) Very High Very Low
- **Conservation Value:** Moderately High (0.25) Very Low Very High
- **Wildlife Linkage:** Very Low (-1.00) Very Low Very High

Cost

- **Project Owner:** 3rd party developer
- **LCOE:** 4.1 ¢/kWh
- **Total Capital Cost (CAPEX) Adjustment:** 100%

Detailed LCOE Inputs

- **Capacity Factor** 26.56%
- **Return on Equity** 10.4%
- **Capital Cost** 1.91 $ / W
- **Debt Term** 20 years
- **Fixed O&M** 20.36 $ / kW /Year
- **Debt rate** 6%
- **Fixed O&M Escalation** 2%
- **Debt (total project costs)** 50%
- **Degradation** 0.7%
- **Energy Price Escalation** 0% / year
- **Discount Rate** 6%
- **Tax Rate** 40%

Technical Guidance

At the onset of the project, a TAC was selected to help shape the audience, datasets, functionality, and user experience of the tool. The purpose of the TAC was to provide strategic guidance for the project by participating in meetings held by teleconference. TAC members were selected from the target user audiences and included members from environmental organizations, energy agencies, renewable energy developers, local planners, and utilities. Moreover, TAC provided reviews and comments at two major milestones in the project: (1) on the initial draft of the tech spec and (2) during the initial testing period (beta testing) of the developed tool. At each milestone, a conference call and key areas for feedback were presented with supplemental detailed materials.

Additional communication among stakeholders was provided at the two TAC meetings (10/26/16 and 3/16/17); communication amongst the stakeholders enhanced the use of datasets and the overall functionality of the tool. The meetings also served as an opportunity to increase awareness for this work among stakeholders currently engaged in renewable development and environmental conservation efforts in the Lancaster Area. An organized list of comments and how they were addressed are included in Appendix B.

Parties were also engaged for their technical expertise in the various applications and datasets that were leveraged in the implementation of this tool. For instance, utility participants secured approvals so this tool could use public distribution capacity maps in the Lancaster region. LA County and Lancaster TAC members had participated in activities related to local planning for renewables in the Lancaster area and identified additional datasets that could be used. The Energy Commission and environmental community participants offered knowledge on other DG and environmental planning at the state and regional level.

Programming

The development process was broken down into four separate sections that were completed in parallel:

1. **Front-end Development**: the User Interface (UI) for the DG Screening tool was created using React Redux. React is a JavaScript view library and Redux is a predictable state container for JavaScript apps; working together, applications behave consistently, run in different environments (client, server, and native), and are easy to test. These are two JavaScript libraries that are popular for building modern web applications.
2. **Back-end Development**: the Applications Programming Interface (API) was created using Flask library which is a Python web framework for making lightweight and scalable web applications and APIs. The code is written in Python 3, the latest release of Python language at the time of development.
3. **Database:** all data was pre-processed and stored in PostgreSQL (v9.5). PostGIS extension is used for adding spatial support to the database.
4. **Map Tiles**: all tiles and overlays are pre-rendered using various tools such as mapnik and tilemill.

Amazon AWS cloud services are used for deployment and hosting the UI scripts and templates, the API code, the database, and all the image tiles for map overlays.

Beta Testing

To review the functionality and design of the tool, the core project team conducted an extensive beta testing phase after the initial development of the tool. After the internal testing was complete, the tool was made accessible to the TAC, and a live demonstration was performed during a meeting to present the beta version and to solicit feedback.

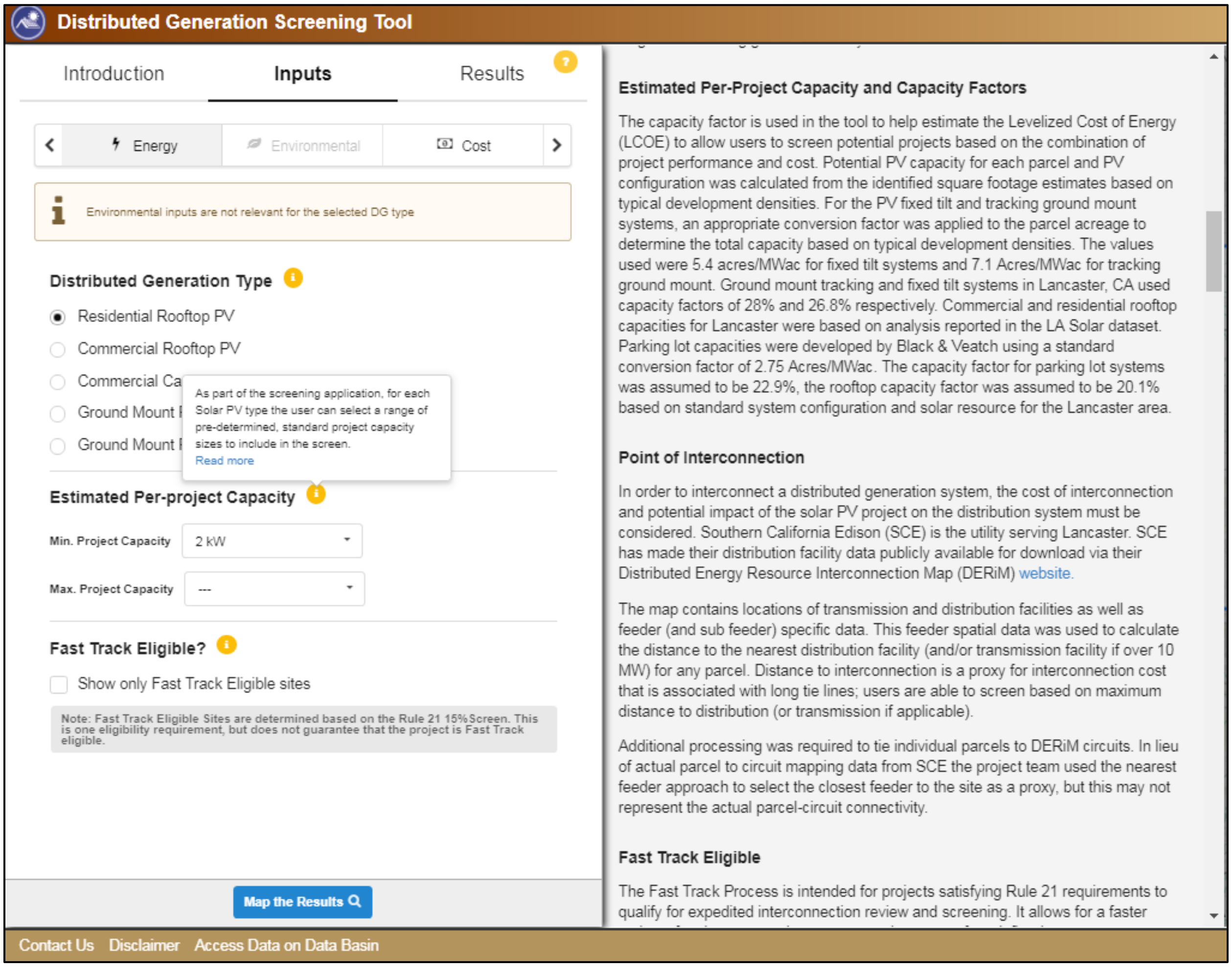
Help Files and Documentation

To support users, help files were developed and are provided within the tool. Throughout the tool, info icons are included to provide short informational text as signified by the info icon ⓘ. If additional information is required, each blurb links to a section in the help text hosted in the tool.

The expanded info icon and in-tool help text are depicted in Figure 8. The help text in the tool can also be accessed by clicking on the yellow question mark icon located next to the **Results** tab. The help documentation is easily scrollable and includes a detailed description of the purpose of the inputs and includes links to the GIS layers hosted on Data Basin where available.

On the welcome page of the tool, a link is provided to a YouTube tutorial video that was developed as an additional resource for users. The video tutorial script and all help documentation text were provided to the TAC members for review, and all comments were implemented in the online tool.

Figure 8: Help Documentation

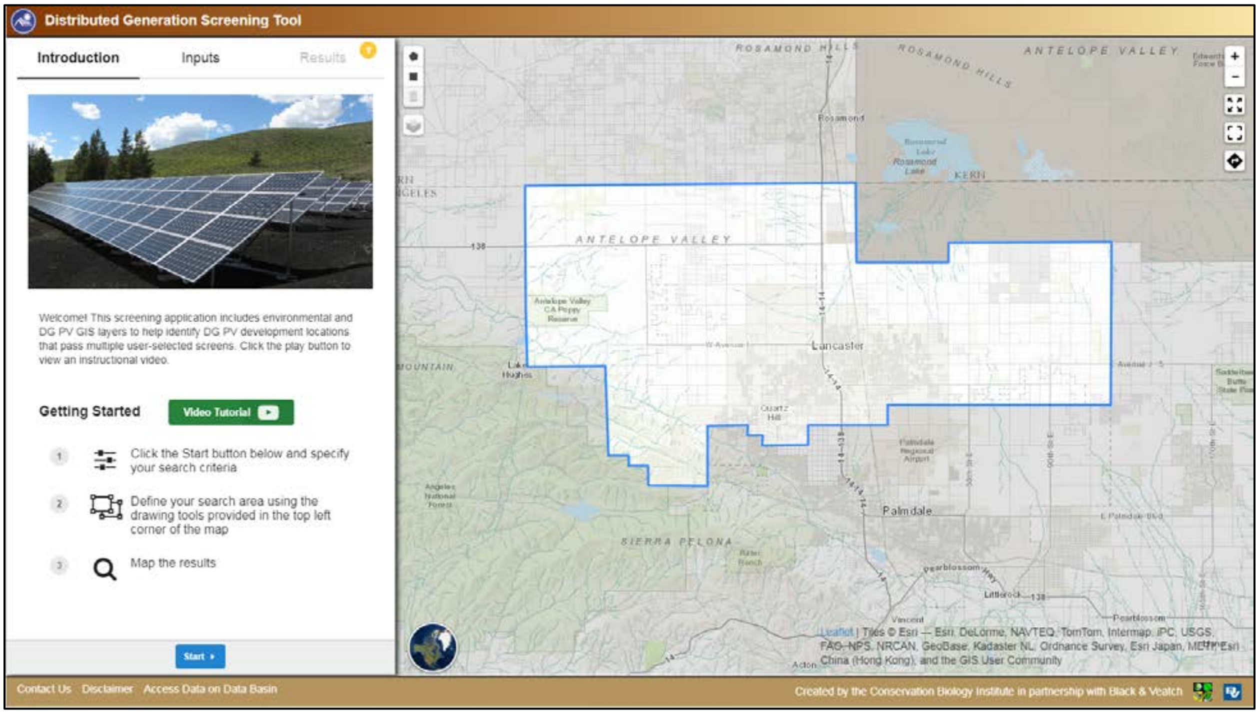


CHAPTER 4:
Project Results and Case Study

Tool and Access

The pilot DG Screening Tool includes environmental and DG PV GIS layers to help identify DG PV development locations in Lancaster, CA, that pass multiple user-selected screening criteria. Figure 9 depicts a screenshot of the Welcome page. Figures in Chapter 3 show images from the online version of the tool for the input tabs, result outputs, and help files. The video tutorial is accessed through the green button on the Welcome page.

Figure 9: DG Screening Tool Welcome Page



In addition to the core functionality, the tool includes a number of user prompts that are designed to make the tool easier to navigate. Colored boxes provide real-time feedback on tool functionality based on user inputs. Descriptive error messages were added to provide additional guidance when the user inputs did not result in any available projects or would have returned too many results for the system to handle.

Case Study

After the tool was finalized, a case study was conducted to demonstrate the DG Screening Tool functionality and highlight use cases for four DG types (utility scale, ground mount (tracking/fixed), carport, and rooftop) from the perspective of likely users. In each case, initial user inputs were selected to create an inclusive baseline portfolio. From the baseline, parameters were adjusted to represent a range of input selections different users might select for a specified DG type. Four base cases were developed and sensitivity cases were used to explore modifications to the environmental, design and economic inputs. Results of the selected cases and tests were recorded using the reporting function of the tool and summarized in terms of portfolio capacity, number of available projects and cost ranges.

Case 1 – Ground Mount, Tracking System (3-20+ MW), 3rd Party Owned

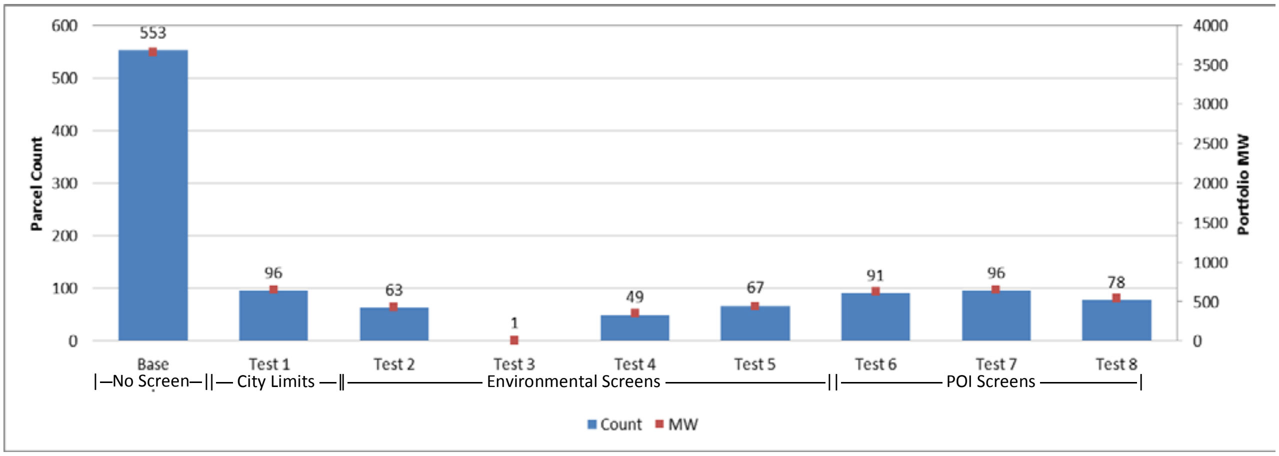
This case was selected to explore the types of screens of interest to a third party DG PV developer of larger-sized systems. Given the proliferation of flat, developable land and high solar irradiance in Lancaster, environmental requirements and distance to POI are key factors for developers in determining project feasibility. Test cases were developed to represent interconnection and environmental screens that could be used to remove anything but prime parcels. Table 3 summarizes inputs changed under each test case, with detailed inputs provided in the appendix.

Table 3: Case 1, Test Inputs

Scenario	Study Area	Distance to POI	Environmental Screens
Base	City limits + surrounding area	Any	No constraints
Test 1	City limits	Any	No constraints
Test 2	City limits	Any	Moderate and high development areas only, limited focal species
Test 3	City limits	Any	High development areas only, limited focal species, low conservation
Test 4	City limits	Any	Low conservation areas, moderate wildlife linkave
Test 5	City limits	Any	Wetlands excluded
Test 6	City limits	1 miles	No constraints
Test 7	City limits	1.5 miles	No constraints
Test 8	City limits	0.5 miles	No constraints

As each screen was applied in the test case, projects no longer meeting criteria were removed and available parcels and total portfolio capacity adjusted accordingly. There was a significant variation in results across tests as shown in Figure 10. From this study, the most constrained environmental case was found to be Test 3, where 99 percent of projects in the base case screen were eliminated leaving only one, 3 MW, project. In general, the environmental screens applied in Tests 2 through5 significantly refined the portfolio, while including the entire Lancaster region beyond city limits greatly increased the available DG capacity in the base case. Tests 6 through 8 showed that the distance to POI is not a significant constraint in the city limits which indicates close proximity of grid facilities.

Figure 10: Case 1, Test Results Parcel Count and Portfolio Capacity



Since cost adjustments were not applied for these tests, a standard range of 3.5 – 4.1 ¢/kWh was observed for project LCOE in all cases which is reasonable given parcel sizes ranging up to 20 MW.

Case 2 – Ground Mount, Fixed Tilt System (250 kW – 3 MW)

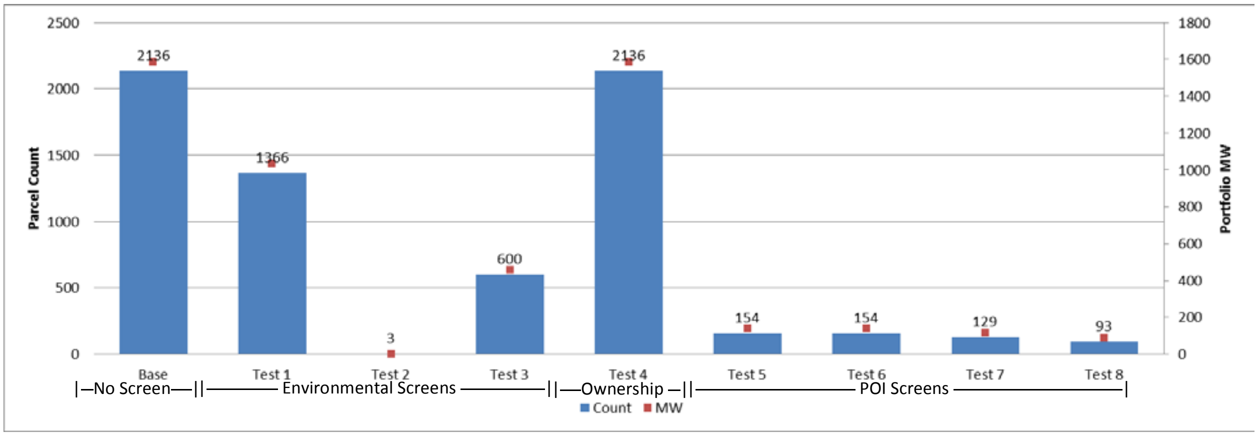
The Case 2 study was designed to examine screens relevant to ground mount, fixed tilt systems. Similar to the tracking projects, the Lancaster area provides many site options with prime solar irradiance, thus POI and environmental considerations often are key to distinguish project sites. The smaller project size associated with fixed tilt can be attractive to a larger variety of owner types including local organizations interested in community solar or load offset. Test cases were developed to examine these aspects as shown by inputs in Table 4.

Table 4: Case 2, Test Inputs

Scenario	Study Area	Distance to POI	Environmental Screens	Owner
Base	City limits	Any	No constraints	3rd Party
Test 1	City limits	Any	Moderate and high development areas only, limited focal species	3rd Party
Test 2	City limits	Any	High development areas only, limited focal species, low conservation	3rd Party
Test 3	City limits	Any	Low conservation areas, moderate wildlife linkage	3rd Party
Test 4	City limits	Any	No constraints	Gov't/NGO
Test 5	Subsection of city	Any	No constraints	3rd Party
Test 6	Subsection of city	1.5 miles	No constraints	3rd Party
Test 7	Subsection of city	1 miles	No constraints	3rd Party
Test 8	Subsection of city	0.5 miles	No constraints	3rd Party

The third party ownership cases resulted in a cost of energy range between 4.1 – 5.0 ¢/kWh for the portfolio while the change in ownership in Test 4 NGO resulted in a range of 9.0 – 11 ¢/kWh for the same parcels. The relative differences in LCOE are associated with the cost of finance and availability of tax credits between parties. Overall results for Case 2 are shown in Figure 11.

Figure 11: Case 2, Test Results Parcel Count and Portfolio Capacity



The most constrained environmental screen was found in Test 2 which identified three parcels for a total capacity of 1.2 MW. The POI screens were found to have impact in the study area examined in Tests 5 through 8. The unconstrained Test 5 returned 154 parcels (135 MW) whereas when POI distance was limited to within 0.5 miles in Test 8 only 60 percent of parcels remained (93 parcels, 84 MW).

Case 3 – Carport, Commercial Parking Lots (1 – 3 MW)

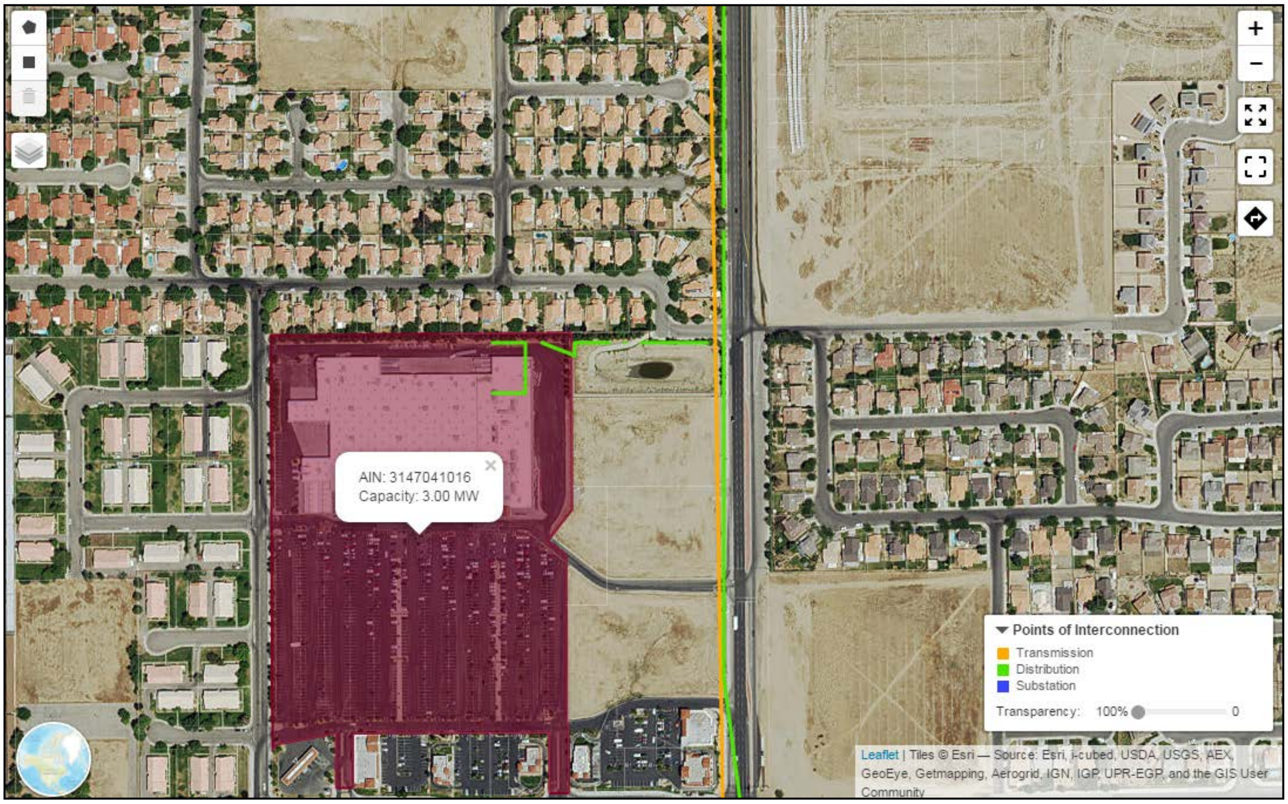
This case examines solar PV carports in commercial and industrial parking lots. Because parking lots are typically located in urban centers, where environmental screens are not particularly useful, they are also typically adjacent to existing electrical infrastructure where the availability of capacity for DG is of particular interest. The project may also be developed by third party installers or directly by the commercial owner of the parking lot. Test cases were developed to examine these aspects. The assumptions and associated portfolio results are shown in Table 5.

Table 5: Case 3, Inputs and Results

	Inputs				Results		
	Fast Track	Owner	CAPEX		LCOE (cents/kWh)	Total Parcels	Total Capacity (MW)
Base	OFF	Commercial	100%	**Base**	7.1 - 7.4	16	25
Test 1	ON	Commercial	100%	**Test 1**	7.1 - 7.4	14	19
Test 2	OFF	3rd Party	100%	**Test 2**	5.4 - 5.6	16	25
Test 3	OFF	3rd Party	80%	**Test 3**	4.5 - 4.6	16	25

The results show that two of the largest parcels were screened out when using the Fast Track screen. In addition, ownership and CAPEX adjustments were found to impact LCOE. Given the limited number of parcels matching these criteria, it was useful to examine the most attractive parcels by applying a Google Earth layer within the DG Screening Tool. Figure 12 shows a screenshot of the tool for the largest parking lot area with nearby Fast Track capacity. Within the tool, the facility was identified to be a Walmart Supercenter.

Figure 12: Google Earth & SCE Grid for Largest, Fast Track Parcel Selected by the Tool



Case 4 – Residential Rooftop, Ownership, LCOE & DG Size Screens

To review relevant features of a residential rooftop portfolio, a study area was selected in a neighborhood in northwest Lancaster. Project capacities for residential sites are determined by the rooftop size of a particular home. In addition to development directly by homeowners, the project may also be developed by third party installers. Test cases were developed to examine these aspects. The assumptions and associated portfolio results are shown in Table 6.

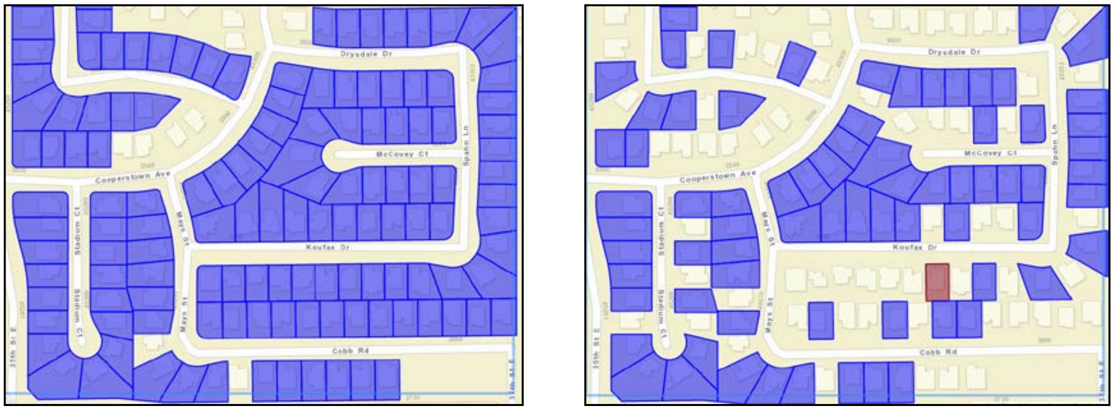
Table 6: Case 4, Test Inputs and Results

	Inputs				Results		
	Size Range	Owner	Max LCOE		LCOE (cents/kWh)	Total Parcels	Total Capacity (MW)
Base	2-30 kW	Residential	Max	**Base**	5.8 - 7.4	290	5.35
Test 1	10-20 kW	Residential	Max	**Test 1**	6.1 - 6.6	126	1.96
Test 2	2-30 kW	3rd Party	Max	**Test 2**	5.7 - 7.3	290	5.35
Test 3	2-30 kW	3rd Party	6.5	**Test 3**	5.7 - 6.4	252	5.05

The results demonstrated that by restricting project size, the total available parcels were significantly constrained (57% reduction in parcels), and the LCOE range was narrowed due to economies of scale in accordance with the size. Change in ownership type had a limited impact on the overall LCOE, and implementing a LCOE maximum threshold eliminated projects with energy costs above that value.

It was observable from the results interface in the tool that a significantly lower number of parcels met the user-specified criteria in Test 1 as compared to the Base Case. This is demonstrated in Figure 13, which shows a screenshot of results for the same neighborhood under each scenario. It can be seen that the largest and smallest rooftops were removed when the size range was limited between 10 – 20 kW.

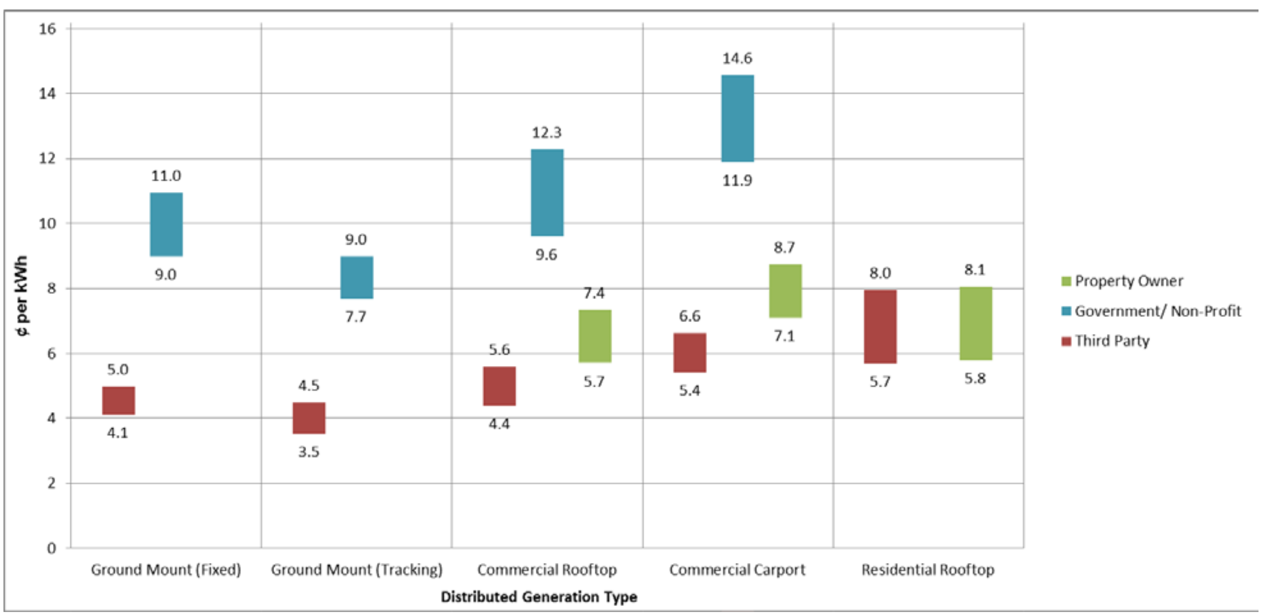
Figure 13: Base Case (Left) and Reduced Number of Selected Parcels, Test 1 (Right)



Case Study Results and Conclusions

The presented studies demonstrate the overall functionality of the DG Screening Tool across a variety of DG types and possible use cases. In addition to the individual cases previously examined, comparisons can be made across the portfolios; the chart in Figure 14 demonstrates a comparison of observed LCOE across the five DG types.

Figure 14: LCOE Range by Ownership and Distributed Generation Type (100% CAPEX)



Additional Lancaster DG findings concluded:

- 2,200 MW of ground mount capacity (fixed and tracking) were identified in Lancaster City Limits (prior to environmental or POI screens).
- Stronger environmental screens were found to be highly effective at screening out otherwise attractive parcels; in some cases, only a single parcel matched the criteria.

- For tracking projects within city limits, the distance to the interconnection points had a marginal impact. For fixed tilt projects in areas outside of the city limits, the screen eliminated up to 40 percent of parcels when constrained to distances less than 0.5 miles.
- Third party development costs range from 3.5 to 8.0 ¢/kWh depending on the DG type.

Overall, the tool has been found to select accurate potential DG portfolios in an easily accessible format based on a unique combination of environmental and engineering geospatial data.

CHAPTER 5: Conclusions and Next Steps

Achievement of Project Objectives

The tool has been developed and is capable of creating DG PV potential portfolios with minimized environmental impact based on user-entered criteria. This section describes how the tool met the specific project objectives.

Identify Environmentally Preferred Locations

The pilot tool provides a transparent, analytically rigorous, publically available tool that enables renewable DG PV site selection in environmentally preferred locations in Lancaster, CA. The environmental screens in the tool utilize high-resolution datasets and provide users detailed results and visualization of environmental data across the entire pilot tool area. In the case study, the ability to refine the selected PV sites by environmentally preferred locations was illustrated by the reduction of the number of selected parcels as the environmental screens become increasingly restrictive.

Enable Stakeholder Participation

The TAC meetings supported and facilitated communication among stakeholders (e.g., project developers, landowners, policymakers, and utilities). By engaging a diverse group of TAC members, the design and implementation of the tool benefited from the varied expertise and stakeholder participation. Comments and recommendations for expanded environmental considerations from the environmental community resulted in more detailed environmental screens, which were noted as a key area of interest for developers. The TAC meetings were useful to capture input across stakeholders, identify areas of common benefit, and identify numerous areas for future analysis. The tool could be used in a similar fashion to facilitate discussion among stakeholders and reveal areas of agreement and conflict in a systematic way.

Document Lessons Learned

Throughout the pilot tool development, the project team evaluated data availability and programming capability that could be used to achieve desired tool functionality. Following are key findings learned as a result of developing this pilot tool.

Data Availability

Readily accessible data, at the appropriate granularity, was used to enable the integrated functionality of the tool. The datasets used were mostly available for public use and accessed via open source platforms. Some datasets relevant to the tool development were found to be inaccessible or under development as described below. To address the previous issue, alternative datasets had to be obtained or the functionality of the pilot tool was reconsidered.

Importantly, the granularity of the data sets available made Lancaster an excellent place to implement and test the pilot tool. Expanding the tool to cities where data values are relatively homogeneous across a city will yield simplified results for which the tool is not necessary. Access to the data was a critical component of success.

Lancaster Solar Carport Data

The LA County Solar Maps provided high-resolution solar resource information for residential and commercial rooftop facilities. In the 2017 update to the Solar Maps, LA County will include a carport potential estimate; however, this version was not available at the time the tool was constructed. An independent analysis was performed to develop the carport data for the tool.

LA County RE Zoning Geospatial Resources

In early 2017, a Renewable Energy Ordinance (REO) was adopted by the LA County Board of supervisors that established standards and conditions for small rooftop and parking lot solar projects as well as utility-scale. This reflects the need for careful review of these projects to minimize environmental and community impacts. Renewable zoning maps reflecting the REO were not accessible on the timeframe of the project. Thus, RE guidance was used to implement zoning within city limits.

Distribution Interconnection Costs

As part of the CPUC Distributed Resource Plan, utilities are developing Locational Net Benefit Analysis to analyze a portfolio of projects at multiple locations responding to one or more grid needs. When available, locational value to the grid may be used in future versions of the tool to provide additional screening metrics related to the locational cost and benefit of project interconnections.

Environmental Data Findings

One reason this study area was chosen was because of the availability of the foundational environmental spatial datasets, which were generated from the DRECP and subsequent work on updating the West Mojave through a statewide energy assessment and the Antelope Valley Regional Conservation Investment Strategy (RCIS) analysis. Expanding work through the ongoing statewide energy assessments, regional conservation assessments, and additional RCISs will make it possible to expand this tool to other regions throughout California. Without high-resolution and robust environmental data sets, the screening power of this tool will be less than adequate.

Software Challenges

The pilot tool helped identify key challenges with the amount of data that the tool processed. To reduce processing times, calculation intensive processes were performed outside of the tool rather than in real time where possible. The development process for this project developed the user interface simultaneously with the calculation engine, improving the efficiency of tool development. Also, by doing this, tasks were broken down into independent components and working on each part did not interfere with the other. As for developing UI and User Experience flow, having a concrete design upfront can introduce challenges. The initial design should be more flexible to leave room for adaptive changes as the tool is being built so user feedback, design inefficiencies, functionality, and aesthetics can be easily incorporated.

LCOE Calculations

Initially, the project team envisioned performing on-the-fly LCOE calculations for parcels meeting selected criteria in real time. By interfacing with an existing LCOE SAM calculator from NREL, the DG Screening Tool would send user-specified financial assumptions to SAM and process the LCOE for thousands of parcels in real time. Upon researching, there was no identification of a sufficient method to perform the potentially thousands of SAM calculations in a way that would achieve the responsive capabilities of the tool, so LCOE values were pre-calculated for defined user inputs. Black & Veatch has an interface coded in Python that can work with SAM quickly; the authors would like to include this functionality in a future version of the tool.

Interconnection Calculations

The project distance to POI calculations were implemented as a real time calculation in the tool. The algorithm accepts a user-entered maximum distance to interconnection points and calculates whether a POI satisfying this requirement is available to each parcel. The POI calculation has been a computational constraint limiting the functionality of the tool. Users risk the tool timing out when POI calculations are performed for large numbers of parcels, and the study area must be reduced to perform this type of analysis.

Parcel Count

The tool is limited in the number of results that can be returned to maintain its performance and speed. If this number is exceeded, an error message is displayed that indicates only 3,000 parcels can be shown. The user is requested to adjust the inputs to be more restrictive or define a smaller study area.

Recommended Next Steps

The following section discusses the follow-up and next steps recommended by the project team that would be required to keep the tool relevant, advance the functionality of the tool, and use the tool for new geographical areas.

Periodic Updates and New Lancaster Datasets

The datasets used in the tool have been uploaded to Data Basin according to the most recent vintage. Since real time updates are not available for several data layers, they will need to be updated periodically to remain relevant. Each dataset is maintained on a different revision schedule ranging from equipment prices (which may change on the order of weeks) to solar resource data (which will adjust on the order of years). One near term update will be the revision to the LA County Solar Maps including carport data for the county. This analysis could be benchmarked against the carport data in the tool and updated as needed. Furthermore, the LA county RE zoning geospatial data can be incorporated for the areas outside of the city boundaries once this data becomes available. To remain relevant, it is recommended that the tool be updated at least twice annually to ensure relevancy. Black & Veatch and CBI are exploring funding opportunities with renewable energy developers, cities or utilities to update this work on a continuing basis.

Enhanced Functionality

The tool functionality may also be improved to provide greater uses and more processing capability. Two such improvements include implementing the LCOE calculation that would connect to NREL SAM via the python interface developed by Black & Veatch as well as identifying opportunities to improve interconnection calculations. Generally, it is recommended to identify methods for reporting large results in a way that is meaningful to users but that will eliminate the current limitations of displaying only 3,000 results. Finally, additional user features may be considered, such as the ability to contact landowners from the tool interface (though privacy considerations about including such information in a public tool would need to be addressed).

The DG Screening Tool could be easily modified to advance the benefits of clean energy in low-income and disadvantaged communities as well. Doing so would help program and incentive designers target disadvantaged neighborhoods or customers using solar PV incentive programs. And once these programs are in place, solar PV developers could identify these areas as financially viable for solar PV development. Additional datasets would be required, including CalEnviroScreen 3.0 mapping of disadvantaged communities. And for individual customers, one may need to be able to enter or secure customer energy usage and rates, in addition to specific incentive levels. Using the tool would allow for the disadvantaged community electricity rate plus the incentive to equal the total cost of the solar facility; a slider bar for the incentive level could be added to easily identify when one or more disadvantaged parcels become economic.

Expanded Geographic Coverage and Regional Datasets

The scope of the pilot project covered only developing the pilot tool for the Lancaster, CA region. Significant benefit may be realized by expanding the tool geographic coverage to a wider region. These would be key benefits to expanding this tool:

- Developers would be able to search for projects over a much wider region (e.g., California), which may result in a greater number of sites fitting specified development parameters.
- More local planners may be able to use the tool for DG planning in their region.
- Greater variation in resource quality, cost and environmental impacts may be observed over a wider area. The contrast between technical, cost, and environmental tradeoffs would be expected to be more dramatic which would provide greater insights for prime locations.

In addition to the potential benefits of expanding the geographic coverage, the availability of datasets outside of the Lancaster area would need to be considered. For example, at this time, detailed environmental data have been developed through active stakeholder proceedings in the San Joaquin Valley and areas covered under DRECP; this area could be ripe for tool expansion. Similarly, the distribution maps in PG&E territory are not publically available and must be requested directly from the utility. This situation would inhibit the tool's usefulness in PG&E territory if the utility did not approve this particular use. The availability of detailed datasets across all inputs would need to be further explored.

As with any tool of this kind, results are dependent upon the timeliness and quality of the underlying data. For environmental data, landscape condition can change dramatically and rapidly over time. Furthermore, new data and information about the existing or newly added focal species is being generated continuously, providing greater understanding about their distributions, life history requirements, and tolerances to disturbance. For the tool to remain valuable, new insights would need to be incorporated and the foundational datasets routinely updated and vetted by experts.

Despite significant efforts in data acquisition, expanding the tool would provide the opportunity to improve the functionality of the tool. One comment that was highlighted from the TAC suggested that when looking at a large area, one wouldn't necessarily need high resolution, and interesting opportunities may exist to refine the filter resolution and data sets used based on the size of the search area.

Expanded DER Technology Coverage

The focus of this pilot tool was on solely solar PV DG technologies, but the tool could be expanded to incorporate other forms of renewable resources including wind, small biomass, small hydro, or even energy storage technologies in the future. Expanding the DER technology coverage of the tool would allow for comparison of environmental impacts (and other factors) across technologies. The effort required to implement this expansion may be significant if it is found that the environmental constraints on each technology are different and if substantial additional research will be required to create relevant databases. Incorporating energy efficiency and demand response options along with energy consumption data could allow even greater customization of results to help a property owner determine the most cost-effective strategies to achieve Zero Net Energy status for their building.

Portfolio Planning Model

In current form, the DG Screening Tool is used to screen out projects that do not meet user-entered criteria. Under this structure, users are limited to a single DG type selection for each search (i.e., ground mount or rooftop, but both types of DG cannot be considered in a single set of results). By adapting this pilot tool into a portfolio planning model, the goal would be to select the optimal set of sites to achieve a total desired DG capacity, perhaps containing multiple DG types with various DG project size constraints. To implement an optimization model, weightings or financial metrics will need to be implemented to compare project types. Furthermore, the overall structure of the tool would need to be revised such that inputs are able to apply to multiple DG types for a single iteration.

Mobile Application

The DG screening tool could be made mobile friendly so users can access the information while visiting the field. It would allow developers to locate neighboring parcels, and access all the information on environmental and interconnection considerations for those parcels. It can also be used in ground verification.

Benefits to California

Combining datasets in a single application offers transparency that will benefit many participants in the DG industry. The key benefits envisioned from this application include expedited project planning, reduced permitting and interconnection screening, and stakeholders more clearly understanding the DG potential to foster proactive system planning opportunities and an improved sense of regulatory impacts.

The tool is designed to demonstrate where projects can be economic in areas of low environmental impact; the goal is to minimize impact and maximize environmental benefits. Because the tool shows where projects can be economic, overlaid with areas of low environmental impact, the hope is that future PV systems in the Lancaster area will target locations with the lowest environmental impact and reduce and minimize habitat area disturbances. The set of base cases and sensitivity cases used in the case study illustrate how the tool can assist different kinds of users in their tasks.

By combining available information into a single application, project planning steps may be streamlined, reducing permitting uncertainty and development costs. The tool also helps facilitate communication among stakeholders over the potential trade-offs involved in applying various screens to a shared, vetted set of spatial data.

By engaging a diverse group of TAC members, the design and implementation of the tool benefited from the varied expertise and stakeholder participation from the solar industry, local agencies, utilities, and environmental organizations. Feedback from the group was positive and indicated that the tool was a successful pilot demonstrating the possibility of using typically disparate existing datasets for local planning.

ABBREVIATIONS

Term	Definition
AIN	Assessor's Identification Number
API	Applications Programming Interface
BV	Black & Veatch
CBI	Conservation Biology Institute
CPUC	California Public Utilities Commission
DER	Distributed Energy Resource
DERiM	Distributed Energy Resources Interconnection Map
DG	Distributed Generation
DRECP	Desert Renewable Energy Conservation Plan
EEMS	Environmental Evaluation and Modeling System
EPIC	Electric Program Investment Charge
GAP	Gap Analysis Program
GIS	Geographic Information Systems
ICA	Integrated Capacity Analysis
LA	Los Angeles (city or county)
LCOE	Levelized Cost of Energy
LiDAR	Light Detection and Ranging
MW	Megawatt
NREL	National Renewable Energy Laboratory
POI	Point of Interconnection
PV	Photovoltaic
RCIS	Regional Conservation Investment Strategy
RE	Renewable Energy
REIPA	Renewable Energy Infrastructure Planning Assistant
REO	Renewable Energy Ordinance
RPS	Renewable Portfolio Standard

SAM	System Advisory Model (from NREL)
SCE	Southern California Edison
TAC	Technical Advisory Committee
UI	User Interface
USGS	United States Geological Survey

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APPENDIX A: TECHNICAL SPECIFICATION

MEMORANDUM November 20, 2016

To: California Energy Commission, CEC Project Number EPC-15-029

Re: EPC-15-029, Final Technical Specification

Black & Veatch and Conservation Biology Institute (CBI) were awarded a grant from the California Energy Commission (CEC), under their Electric Program Investment Charge (EPIC) program grant agreement number EPC-15-029. As stated in the grant funding opportunity, "The goal of this research topic is to improve local level planning and permitting for distributed generation (DG) facilities and thereby expedites meeting DG goals while minimizing impacts to environmentally sensitive areas and keeping energy costs low."

A.1 Background

Initially called the Distributed Generation Planner ("Planner"), the application will help project developers, local planners, utilities, landowners, and the public effectively screen local DG PV for environmental considerations.

The following are the Problem and Solution statements for the work:

- Problem: environmental information is not widely available, particularly for DG photovoltaics (PV), and environmental, engineering, cost and electrical distribution grid data are usually disparate.
- Solution: Develop an application that allows for easy screening that combines key information together for planning and decision making that includes:
  - Project details and engineering cost,
  - Distribution grid integration information, and
  - CBI landscape scale renewable energy planning models.

The goal of combining datasets in a single application is to offer transparency that will benefit many participants in the DG industry. The key benefits envisioned from this application include expedited project planning, reduced permitting and interconnection screening, and clearer stakeholder understanding of developable DG potential to foster proactive system planning opportunities and an improved sense of regulatory impacts.

A.2 Scope of work

The application will be built upon the CBI Data Basin platform and will use appropriate analysis capabilities captured in other CBI tools – primarily the RE Infrastructure Planning Assistant, and potentially others including the RETI 2.0 Environmental, Land Use Planner, and the DRECP Site Survey Analyst. The following outline identifies all key tasks included under this scope of work:

1) <u>Task 1.</u> Develop an Application
    a) Define the application's desired functionality, including:
        i) Intended audience and outputs,
        ii) Analytical methods, and
        iii) User interface
    b) Draft technical specification for the application
        i) Seek TAC input
    c) Prepare a stakeholder specification comment summary
    d) Develop final Technical Specification
2) <u>Task 2.</u> Pilot the Application in Lancaster CA,
    a) Develop the DG Environmental Planner as an interactive online application for selection of environmentally preferred sites for DG PV in Lancaster, CA
    b) Prepare the environmental and DG PV data sets,
    c) Perform quality assurance testing,
    d) Conduct webinars to secure comments on Beta version
        i) Seek TAC input
    e) Create user tutorials script and help files
        i) Seek TAC input
    f) Revise and launch the final pilot application on Data Basin
3) <u>Task 3.</u> Facilitate Communication
    a) Prepare Lancaster Case Study,
    b) Create presentation materials, and
    c) Hold one or more webinars to publicize the pilot, on-line application.

This document and the associated Power Point presentation will serve as the Draft Technical Specification deliverable under Task 1.b.

A.3 (Draft) Technical Specification Overview

This draft technical specification ("tech spec") describes the Distributed Generation Environmental Planner that can be used to screen suitable sites for solar PV deployment. This tech spec seeks to define the following major Planner attributes: data inputs, screening criteria, user inputs, functionality, results, and reporting. Accompanying this document is a Power Point Presentation containing screenshots of the proposed Planner layout. Select images from the Power Point are included throughout this draft specification to provide visual references (such as Figure A-1 below).

A subset of critical information from this tech spec will be reviewed by the Technical Advisory Committee during a workshop and subsequent comment period. This includes the data sources, the user interface mock-ups, the functionality mock-ups, as well as the results output mockups. The final version of the tech spec will serve as the application design standard in preparation of the Beta Version of the application.

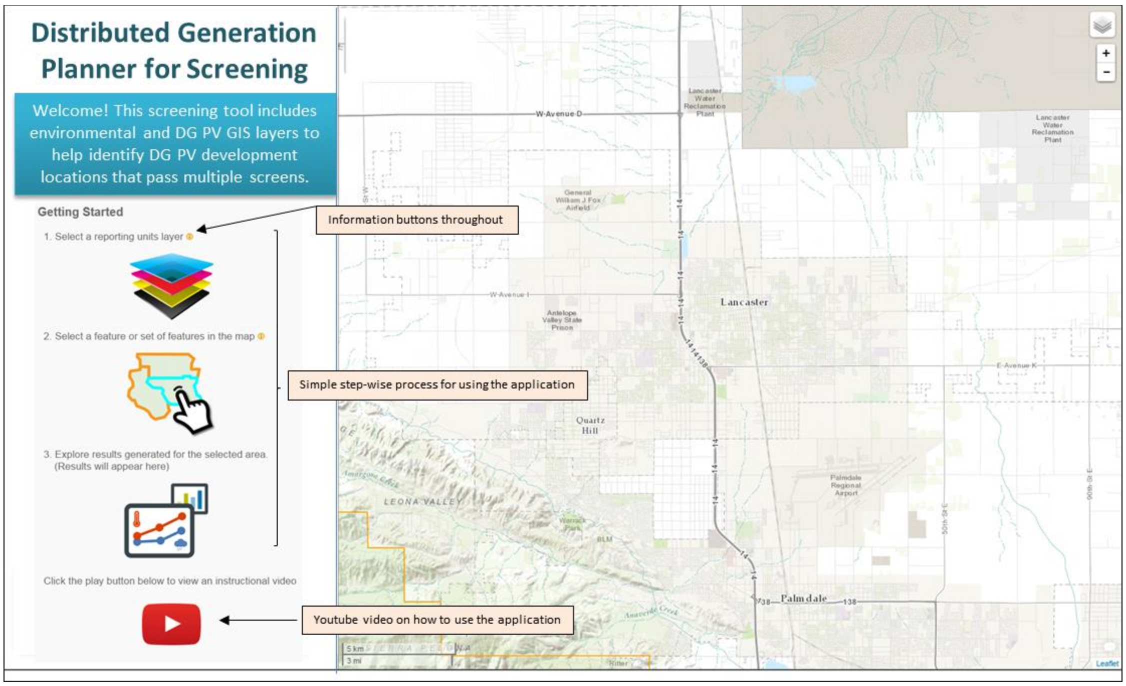

Figure A-1 Distributed Generation Planner Application Home Page

At a high level, the Planner is envisioned as a **screening application** in which a user will step through a series of search criteria tabs to define acceptable PV project attributes. The application will include three DG Solar PV system types including Rooftop, Parking Lot and Ground Mount (fixed and tracking). The Planner application will leverage existing datasets to identify eligible project sites meeting the user criteria.

The Section 4 through 7 of the technical specification detail the key characteristics of the Planner and discuss data attributes, data inputs, user inputs and screening criteria, and outputs and reporting requirements of the DG Application Planner.

A.4 Data Attributes

The first priority in gathering and including data in the DG Environmental Planner will be to incorporate the main data layers that cover the production and economics of DG PV. Specifications of key data attributes described below include boundary extents, security requirements, granularity and structure.

4.1 Data Boundary

We assume the data boundary for this prototype will be the city limits of Lancaster, CA.

4.2 Data Security

All datasets will require determining a level of security before the data is incorporated. The data can be treated within the application one of three ways, designated by the three levels of security. The allowed use for each security level is shown in the following table:

SECURITY LEVEL	DATA CAN BE USED IN THE APPLICATION	VALUES CAN BE SHOWN	DATA CAN BE DOWNLOADED
Level 3	Yes	Yes	Yes
Level 2	Yes	Yes	No
Level 1	Yes	No	No

If the data is so sensitive that it does not meet one of the three levels, it cannot be included in the application.

4.3 Data Availability

The team will seek data input using the most recent and most granular datasets available. More and more geospatial data are being made available in real-time. To prove the concept of the prototype, the initial data will be captured as a static data set, because we believe incorporation of the real time data would result in significant time delays in application run time. This static data set will require updates moving forward.

The TAC Members also emphasized the importance of regular updates moving forward. The future goal is for this Planner Application to use data sets that are available electronically so that the calculations are done with the most recent and granular data and do not require regular updates.

4.4 Data Granularity

The application will be designed to perform DG screening at the parcel level. Every effort will be made to identify underlying data sources that provide parcel level data resolution. If any of the data layers are less granular, they will still be included, but mapped to the parcel level. An example of a less granular data layer being mapped to the parcel boundaries is shown in Figure A-2.

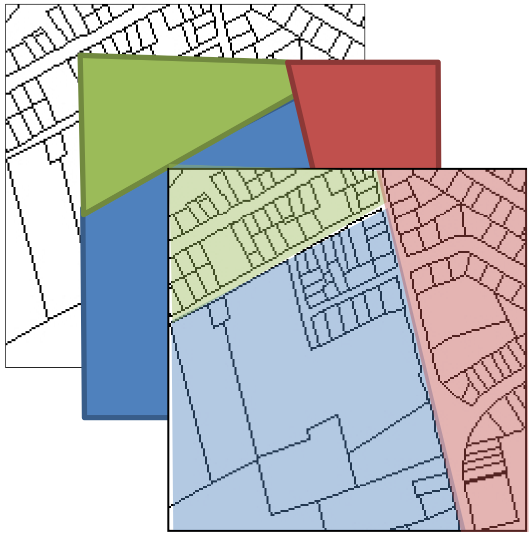

Figure A-2 Conceptual Example of Mapping Less Granular Dataset to Parcel Granularity

4.5 Data Structure

This application will compile data in a geospatial format. Original data will be gathered in a variety of formats including: Microsoft Database, Online GIS Data layers hosted in Data Basin & ArcGIS Web Map, GIS Shape Files and Excel Data Tables. Any information that is not already in a geospatial format will include identifiers to allow mapping data to individual parcels.

A.5 Datasets

There are four main groups of data that will be included for the DG Environmental Planner application. They include: (1) Solar PV Resource Datasets, (2) Solar PV Cost Datasets, (3) Land and Environmental Exclusion Data, and (4) Transmission and Distribution Data. For each group of data there are multiple proposed datasets that will be incorporated into the application. The following section describes each of the key datasets.

5.1 Solar PV Resource Datasets

Independent resource datasets will be gathered for each Solar PV type (rooftop, parking lot and ground mount) in the Planner. As part of the screening application, for each Solar PV type the user will be able to select a range of pre-determined, standard project capacity sizes to include in the screen. The capacity factor will be used in the application for Levelized Cost of Energy (LCOE) calculations to allow screening based on project cost.

The following section discusses key datasets used to determine project capacity and capacity factor.

Rooftop Solar

Rooftop solar performance data will be based on the Los Angeles (LA) County Solar Map.[5] This dataset contains project sizes calculated for each residential and commercial rooftop in LA County.

The maps include solar irradiation calculations every 5 x 5 ft^2. Measurements include shading from trees, roof features (chimneys, other stories, etc.), roof pitch, nearby buildings and mountains. The dataset includes a variety of detailed information including total roof area, area optimal for solar, estimated solar output and property information. A screenshot of the LA County Solar Map is shown in Figure A-3 and demonstrates the type of data available for each parcel.

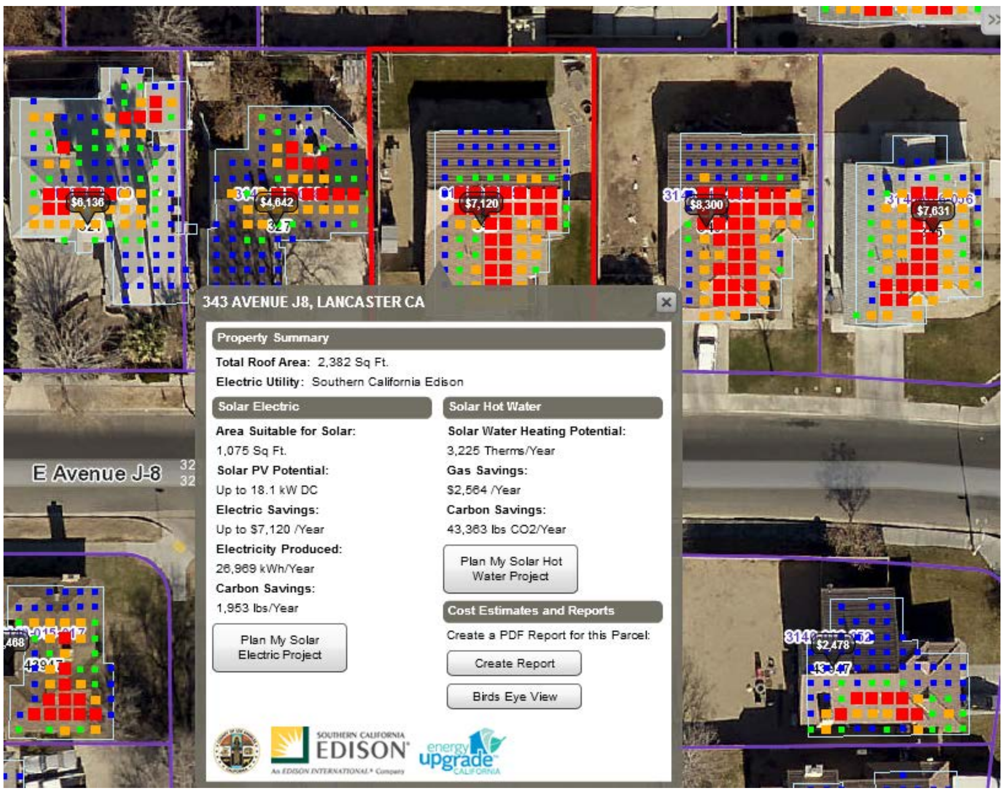

Figure A-3 LA County Solar Map Data

The DG Planner will utilize the kW_{dc} capacity and kWh/Day energy reported in the LA County Solar Map to define the capacity and capacity factor for each parcel in Lancaster with a residential, commercial or industrial rooftop. An Inverter Loading Ratio (ILR) typical of rooftop Solar PV will be provided by Black & Veatch to convert the kW_{dc} from the map to kW_{ac} which is the unit of capacity used in the application. The LA County Solar map was originally created in 2006 and is maintained by LA County.

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[5] The proposed Rooftop Solar Resource data can be found here http://solarmap.lacounty.gov/#. Black & Veatch has confirmed approval for use of this data in the DG Planner with LA County.

LA County has procured an updated LiDAR assessment of irradiation and rooftop potential. Unfortunately, this update will not be available until Q2 or Q3 of 2017. Therefore, the current LA County data does not contain 10 years of new buildings and other incremental shading factors. If the prototype is proved to be useful, future iterations of the application might be able to include updated versions of this data to replace the selected rooftop capacity and energy production.

Carport Solar

Black & Veatch's aerial imagery analysis will be performed for Lancaster to identify parking lot potential in the city. USGS orthoimagery is retrieved from the through USGS Earth Explorer site and GIS analysis is used to identify the parking lots. Figure A-4 shows the results of this analysis which will be paired with parcel boundaries to identify square footage of parking lots on each parcel. Potential PV capacity for each parcel can be calculated from the identified square footage estimates based on typical development densities. A standard discount will be applied to derive developable potential for suitable development area which represents the per parcel capacity. Capacity factor for carport systems will match the rooftop capacity factor.

Figure A-4 Parking Lot Imagery Analysis (Parking Lots in Blue)

On the same time frame as the Rooftop Solar updates, LA County has indicated that parking lot data will be added to the LA County Solar Map. Thus, it is not available until mid/late 2017. In future iterations of the application, this data should be compared to the Black & Veatch aerial imagery analysis to determine if new LA data should be included.

Ground Mount Solar

Ground Mount Solar performance data developed for the RPS Calculator will be used for resource capacity factor in the Lancaster, CA area. This analysis utilizes NREL's 10 km x 10 km irradiance data and is interpolated to 4 km x 4km resolution. Given the relatively small size and consistent resource of the pilot area, a single average capacity factor for the city will be used for tracking and fixed tilt systems. Therefore, the capacity factor will only change between fixed tilt systems and single-axis tracking ground mount systems. As such, the project LCOE will be consistent between two locations for the same combination of project type, project size, and owner (e.g. all ground-mount fixed tilt projects that equal 1 MW in size with a commercial or 3rd party owner will have the same LCOE).

To determine the available Solar PV capacity available on each parcel, a MW/acre conversion factor will be selected for fixed tilt and tracking systems. Project assumptions on mounting structure will be characterized by project size, where projects >3 MW will be considered tracking systems and ≤3 MW will be fixed tilt. In reality whether a system will be fixed-tilt or tracking will depend on more factors than just size; this was enacted as a simplification. The appropriate conversion factor will be applied to the parcel acreage to determine the total capacity based on typical development densities. For projects that contain a building or parking lot, the identified rooftop and parking lot potential will be subtracted from the calculated ground mount potential for the parcel.

Special attempts will be made to identify an approach to remove parcels that are not suitable for ground mount solar PV development. In addition to the environmental restrictions discussed in Section 5.3, the project team will strive to exclude urban area parcels such as parks, golf courses, etc. It is expected that this can be achieved through use of the LA County Land Type database. We hope to use the zoning information from the City of Lancaster, to identify parcels where solar PV development for ground mounted systems is clearly allowable and clearly not allowed at all. There will likely be a number of zone types that will be unclear, but could go either way depending on how the land is used. This aspect of the application will be implemented depending on availability of a data source that can be applied to filter sites of these natures.

5.2 Solar PV Cost Data

Black & Veatch intends to calculate a number of Levelized Cost of Energy (LCOE) values for each DG Type based on standard user and system types. This analysis will use capital cost curves for DG systems of each type (Rooftop/Carport/Ground Mount) based on cost curves developed for the RPS Calculator V6.3 and refined by Black & Veatch to reflect latest market trends.

LCOE is a computationally intensive calculation to run in real time due to the requirement for a discounted cash flow calculation. To reduce computational times and allow for scalability, predefined financing assumptions will be created for the following user types: 3rd Party Developer, Residential Owner, Commercial Owner, and Government/Non Profit Entity. For the same reason, standard project sizes will also be selected and the various LCOE values will be pre-calculated for each DG type, financing assumptions (user type) and size.

Standard financing assumptions will be defined for each user type based on typical industry values. Project sizes were selected to be representative of natural breakpoints in project capital costs and technology considerations (e.g. fixed verse tracking). Figure A- reflects the 80 various permutations of DG type, project size, and financing assumptions that will be precalculated and included in the planner.

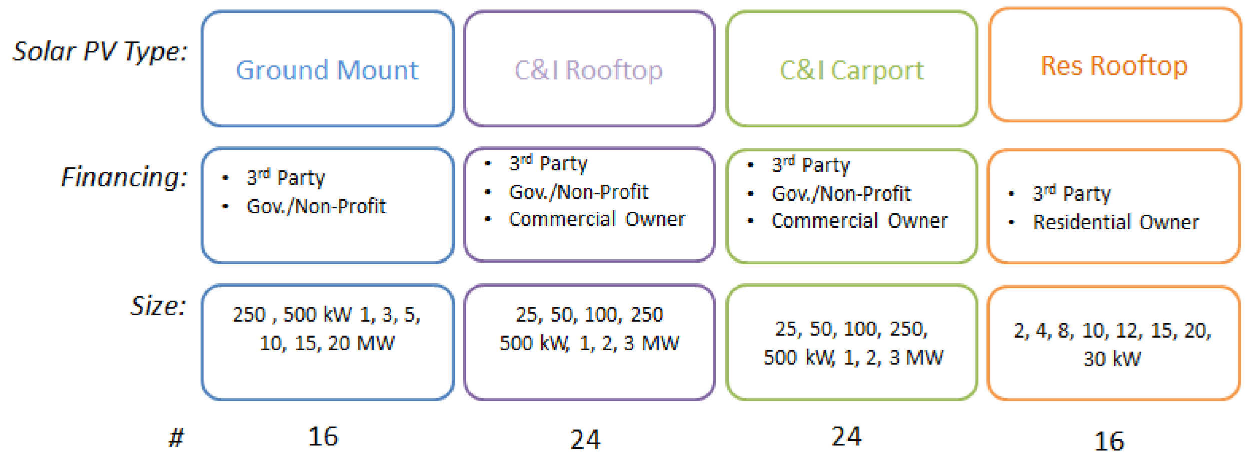


Figure A-5 Standard LCOE Calculation Space (80 Total Calculations)

The calculated LCOE values will be stored in the Planner and indexed to parcels based on the project attributes selected by the user. Actual project capacity will be rounded down to the nearest standard size to index to the precalculated LCOE values.

Solar PV prices have decreased rapidly and a predicted to continue to decline further. Based on TAC feedback, the application should allow the user to incorporate these capital cost reductions through an input in the application. Using a slider, the user will be able to adjust the baseline LCOE curves up and down in increments of 10% to account for reduction or increase in capital cost values. The application will reference pre-calculated LCOE for discounted capital costs and report these based on user modification of the slider bar between +/- 50% of baseline capital cost assumptions.

Future enhancements are expected to distinguish between similar projects (the same project type, project size, and project owner) in a number of ways. First, once the geographic area can expand beyond one city, differences in solar insolation for ground mount systems will provide an additional factor that will influence the project LCOE based on geospatial resource availability. Second, we plan to add an estimated interconnection cost for all projects, which will be unique to every system (i.e. distance to interconnection point, size of interconnection point). And finally, having an open-ended project capacity size (instead of discreet, pre-defined sizes) that refers to a cost curve in real time will provide further differentiation.

In the future the team will explore the possibility of incorporating SAM Software Development ToolKit (SDK) to perform the LCOE calculation in real time. This will require interface between the Planner and SAM, and potential use of cloud computing to perform required calculations at allowable time delays. It appears that individual parcels would be possible and estimating LCOE for multiple parcels simultaneously would require further investigation. By implementing this functionality, users would be able to set financing assumptions and consider a full spectrum of project sizes.

5.3 Environmental Data

The Planner will allow user defined environmental screening for ground mount systems and will draw upon a number of various geospatial data including environmental exclusions, conservation priorities, terrestrial landscape intactness, conservation value, covered species, wildlife linkage and areas of conservation emphasis. The following section describes each dataset in greater detail.

Exclusions

Exclusions include all areas where solar development is prohibited. Generally, these lands include protected area designations at the federal, state, and local government levels as well as private fee protected areas, conservation easements, and mitigation lands. At the extent of municipalities, solar development exclusions are more likely associated with local zoning plans. Protected areas data is maintained by CBI and a recent update was just completed (2016). Zoning exclusions will be acquired from the City of Lancaster Master Plan and included in the application. The City of Lancaster keeps track of zoning within the city borders, in order to ensure that building or other development is in line with the zoning ordinances[6]. The project team has received the zoning map from City of Lancaster in GIS format.

Mapping exclusions is not a one-off exercise; rather, it changes over time requiring regular updates. All lands that are considered exclusions will never be considered as part of the solution set and will not be queried by the application.

Other Exclusions

An enhanced exclusion layer will be considered to capture any additional exclusion not described in the Exclusions layer.

Conservation Priorities

While not formally designated as exclusions from solar development, we anticipate there are other lands identified as conservation priorities that users of the application may want to exclude from consideration from the outset. Examples include LA County Significant Ecological Areas, proposed advanced mitigation lands, prime farmland, and other high conservation value lands identified through other governmental and non-governmental evaluation processes. The default setting in the application will consider these lands for potential development, but the user can choose to exclude them before running results. The number and type of lands under this category will dictate whether we will present this as a single combined dataset, or show each component individually allowing the user to be more specific about which lands they wish to exclude. For example, the user may wish to exclude Significant Natural Areas as defined by the county but not prime farmland. The West Mojave Assessment preferred areas developed by TNC will be considered as one of the filtering options.

[6] http://www.cityoflancasterca.org/home/showdocument?id=12653

Terrestrial Landscape Intactness

Terrestrial landscape intactness is an important consideration in regional conservation planning. Originally developed for BLM Rapid Ecoregional Assessments and later refined for the Desert Renewable Energy Conservation Plan (DRECP), it has now been completed for the entire State of California at a spatial resolution of 1 km. For the West Mojave region (including Lancaster), CBI has recently completed a streamlined permeability dataset for the region at 270 meter resolution, which is better for this application. Users will be able to select from a range of lands for consideration from most intact to least intact using a slider.

Conservation Value

Combining numerous inputs (endangered and threatened species occurrence, focal species habitat, natural communities, and climate change vulnerability) into a single model allows for many different components of conservation to be assessed together. Using logic modeling software developed by CBI and working with agency and conservation NGO partners, a new conservation values model is underway for the West Mojave at 270 m resolution. Users will be able to select from a range of lands for consideration from lands with the highest conservation value to least based on the model using a slider.

Number of Covered Species

A total of 37 covered species of plants and animals were selected for DRECP and species distribution models generated for each one. All models were combined into a composite grid at both 4 km and 1 km resolution for coarse planning purposes (called the Species Stack). For any given grid cell, results ranged from 1 to 17 potential species being present on the site. The coarse nature of this screening dataset did not require refinement such as removing urbanized portions of the landscape. Therefore, the composite was focused more on what would be there under natural conditions versus what might still exist there today. For this application, we want to try to modify the dataset in a couple of ways. First, we plan to step the resolution down to match the other screening datasets to 270 meters. Second, we plan to remove those areas where each species is likely to no longer occur. Users will be able to filter all parcels by the number of potential covered species that may be present on the site. The greater the number of covered species, the greater the potential mitigation costs.

Wildlife Linkage

Wildlife linkages are extremely important to maintaining conservation values within a region, particularly as a response to climate change impacts. For the Mojave Desert ecoregion, CBI is completing a new set of wildlife linkage maps at 270 m resolution, and while this work will not have much influence within the city limits of Lancaster, it is an important component to include in the pilot Planner as it will be more important in other locations throughout the state. Users will be able to filter how much of existing identified wildlife linkages they wish to avoid in their selection set.

Areas of Conservation Emphasis (ACE II)

The California Department of Fish and Wildlife (CDFW) created and periodically updates Areas of Conservation Emphasis based on a number of biological metrics, including concentrations of species rarity and richness. One of the composite values created by CDFW is "Biorank," which includes metrics from six taxonomic groups (amphibians, birds, fishes, mammals, plants, and reptiles) as well as special natural features (e.g., vernal pools and wetlands). Biorank is reflected as a number between 1 and 5. For the Lancaster area, there are concentrations of rare mammals and reptiles in parts of the region. The data are spatially coarse, but a valuable dataset to consider. Users will be able to filter at what level of biorank they wish to consider in their selection set between 1 and 5.

5.4 Interconnection Data

In order to interconnect a distributed generation system, the cost of interconnection and potential impact of the solar PV project on the distribution system must be considered. Southern California Edison (SCE) is the utility serving Lancaster. SCE has made their distribution facility data publically available for download via their Distributed Energy Resource Interconnection Map [(DERiM) website](). The map contains locations of transmission and distribution facilities as well as feeder (and sub feeder) specific data. Figure demonstrates the data and information.

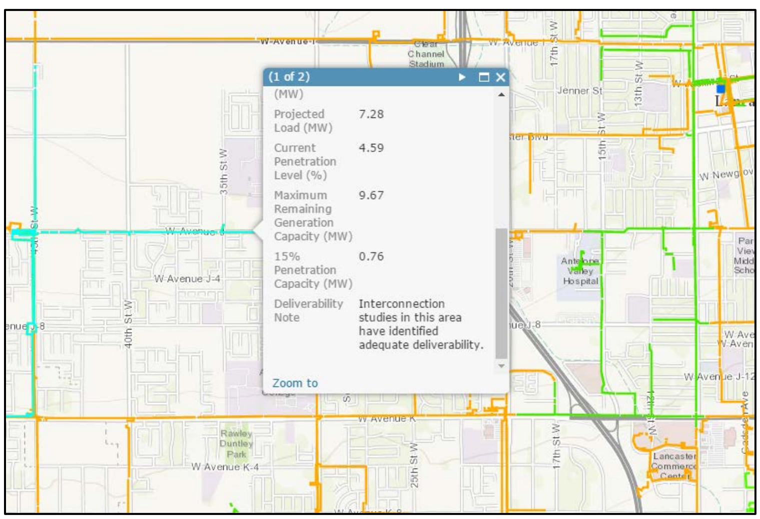


Figure A-6 SCE DERiM Web Map and Data

This feeder spatial data will be used to calculate the distance to the nearest T&D facility for any parcel. Distance to interconnection is a proxy for interconnection facility cost that is associated with long tie lines. Users will be able to screen based on allowable distance to interconnection.

In addition to distance, circuit integration capacity is relevant to a projects' success. During the Fast Track application review process, to satisfy Rule 21, generation must not exceed 15 percent penetration level on the circuit. The circuit available '15 Percent Penetration Capacity (MW)' field in the DERiM data from SCE will be used to implement a Fast Track screen in the Planner. It is noted, that the 15 Percent Screen is only one of multiple screens a generator is required to pass in order to become eligible for Fast Track interconnection. A disclaimer will be made to notify the user that 15 Percent Penetration is not an indication that the project will be Fast Track Eligible.

Additional processing is required to tie individual parcels to DERiM circuits. In lieu of actual parcel to circuit mapping data from SCE the project team intends to use a nearest feeder approach to select the closest feeder to the site as a proxy, but this may not represent the actual parcel-circuit connectivity.

SCE has stated that they make every effort to ensure the accuracy of DERiM data; however, the data is to be treated for information only. SCE makes no guarantee for the outcome of an interconnection request. This disclaimer will be incorporated into the Planner and these data will require update moving forward to remain relevant. Currently SCE updates the DERiM map quarterly.

Project interconnection costs will not be directly reported in the application at this time due to the project specific nature of these calculations. Distance to facilities will be used as a cost proxy and a URL link will be provided in the individual project results to SCE per Unit Distribution Facility costs.

Future iterations of the application might have additional features, including estimating interconnection costs (including upgrades needed), optimizing the interconnection point (at the distribution or transmission system for larger facilities), and perhaps other functionality.

5.5 Summary of Datasets and Information Tracker

The following table summarizes the underlying datasets to be incorporated into the Planner. The data will also be tracked in a data key information tracker that the team will develop and maintain including additional details such as the dataset electronic location, availability for refresh, data structure and key team contact.

Table A-1 – Dataset Summary

DATA SOURCE	DG TYPE	INFORMATION	YEAR	GRANULARITY	SECURITY
LA County Solar Map	Rooftop PV (C&I Residential)	Size & Performance	2006, update in Q3 2017	Parcel	Level 3
Aerial Imagery (B&V Analysis)	C&I Parking Lot	Size	2016	Parcel	Level 2
CPUC RPS Calculator	Ground Mount PV	Performance	Updated 2016	City	Level 1
CBI RE Infrastructure Planning Assistant	Ground Mount	Zoning & Exclusions, Conservation, Intactness, Wildlife Linkage, Covered Species, ACE II	Updated 2016	Parcel, 270 m, 1 km^2	Level 3
SCE DERiM/ICA Maps	All PV	T&D Facility Location & Fast Track Capacity	2016	Sub Feeder	Level 3
B&V Solar Cost	All PV	LCOE Values	2016	90 Standard Values	Level 2
City Zoning Maps	All PV	Parcel Zoning	Latest	Parcel	Level 3

A.6 User Inputs and Screening Functionality

The following section demonstrates the key user defined inputs for the screening application. The application consists of a user defined search area and user input tabs that define the DG system design, environmental considerations and project costs.

The Planner is designed to flow in a logical progression from one tab to the next. Throughout the Planner, user selected inputs will reduce which remaining data sets are needed. Other inputs and tabs in the current and remaining tabs will be adjusted based on the logic applicable to that particular selection. This functionality is designed to limit possible user inputs to realistic options, as shown in Figure . For example, if a rooftop or carport DG type is selected, then the environmental tab will “gray out” since land and environmental impacts are not relevant to this DG Type. The project team will maintain a Logic Flow Chart to capture the internal logic of the application. Users are allowed to click between tabs to modify their inputs and pre-defined, standard inputs will be the default for all input assumptions until modified by the user.

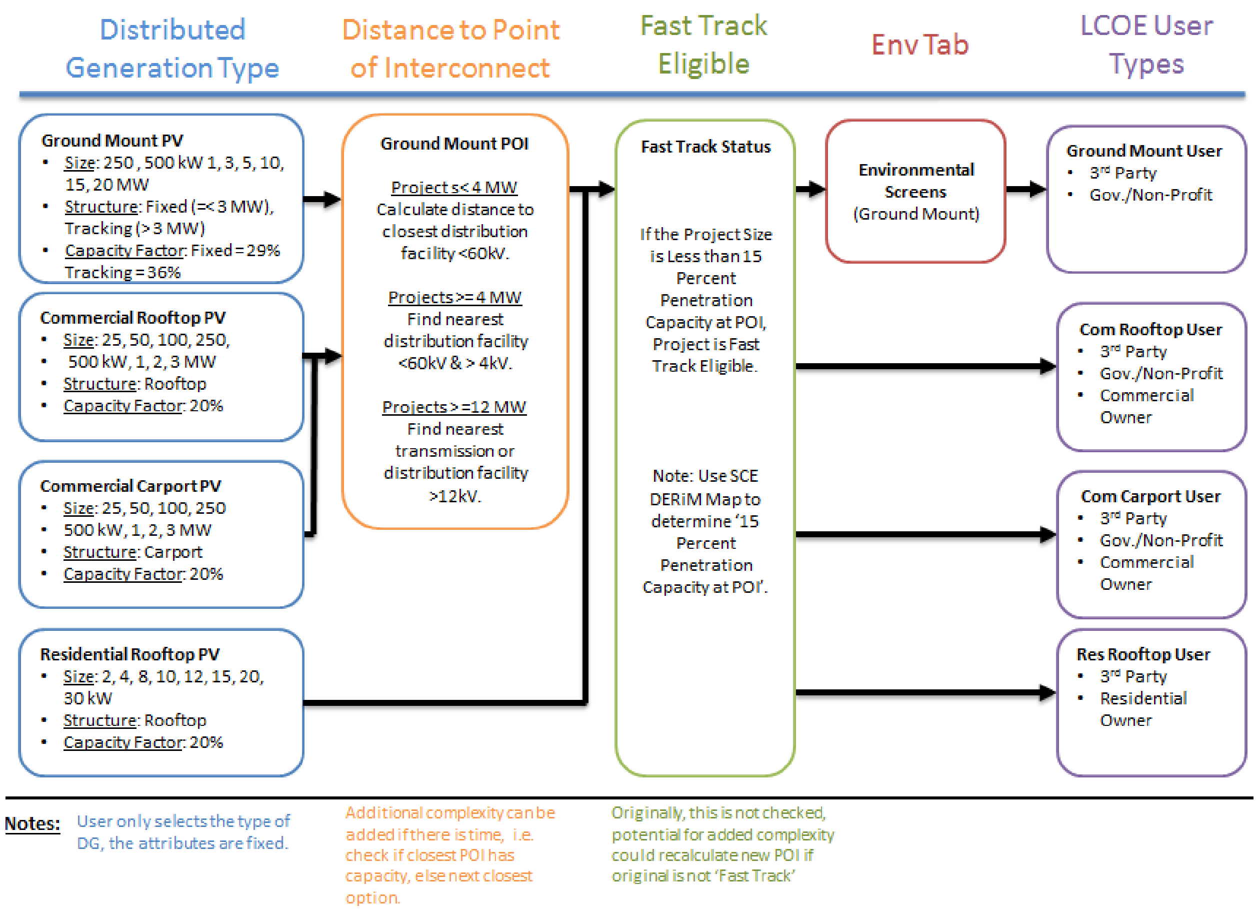


Figure A-7 DG Planner Prototype Application – Decision Logic Flowchart

Throughout the Planner information links and added map layer icons will be included. Where these icons are shown, a user can click on the item for additional information or to view a map layer that shows relevant and detailed information of a particular user input. From any tab, by clicking the "Map the Results" button, the remaining eligible parcel results and report options will be provided.

Each section below discusses one of the user input tabs (system design, environmental and cost).

6.1 System Design Tab

The system design tab (Figure) is the first tab that the user sees after the welcome page (Figure A-1). First the user specifies their desired search area which can be through a manual selection feature drawn directly on the map, by selection of particular land use zones, or defining a city region (e.g., Lancaster). Note there will also be an option to query as an individual land owner that will allow the user to display attribute info for a selected parcel.

After the desired search area is defined, the user will select from five distributed generation types as shown in Figure :

- Commercial rooftop PV
- Commercial carport PV
- Residential rooftop PV
- Ground Mount PV Fixed Tilt (≤3 MW)
- Ground mount PV Tracking (>3 MW)

After the DG Type is selected, the user may choose to define a per-project project capacity as either:

a) a single desired project capacity
    i. The sizes will be pre-determined in this version of the application, and can be chosen from a drop down menu
    ii. This selection will include all parcels capable of supporting this capacity,
b) a maximum and minimum project capacity, where all sites in that range will be included.
    i. The max and min will also be selected from a drop down of pre-determined sizes.
    ii. If the range is wider than one project size, it will include all the parcels that meet that number of project sizes.
        - For example, a ground mount – fixed project type with project size minimum of 1 MW and project size maximum or 3 MW will include all parcels that are able to support 1 MW, 2 MW and 3 MW project sizes.

Next the user will define an allowable distance to a point of interconnection (POI). The default maximum distance for ground mount will be 1 mile, which is a standard generation tie-in (gen tie) length. The application will calculate internally the distance from the centerpoint of each parcel to the POI and screen out any projects that are not within the specified distance. Users can adjust the allowed distance to gather a sense of how many projects disappear at given gen tie lengths.

Finally the user can decide to check the Fast Track status sites. The default setting for this screen will be off. If the user elects to eliminate projects that are not Fast Track Eligible based on the 15 Percent Screen, then this box would be checked. Only projects with project size smaller than the SCE defined 15 Percent Capacity for the nearest interconnection facility will remain in the eligible project set. If a user selects Fast Track and no projects are eligible, a pop up window will occur advising the user that they must either decrease the project size or remove the fast track screen.

Future iterations of the application may allow for more than one type of project types to be selected, and perhaps even a portfolio of projects (e.g., X% residential rooftop, Y% commercial rooftop).

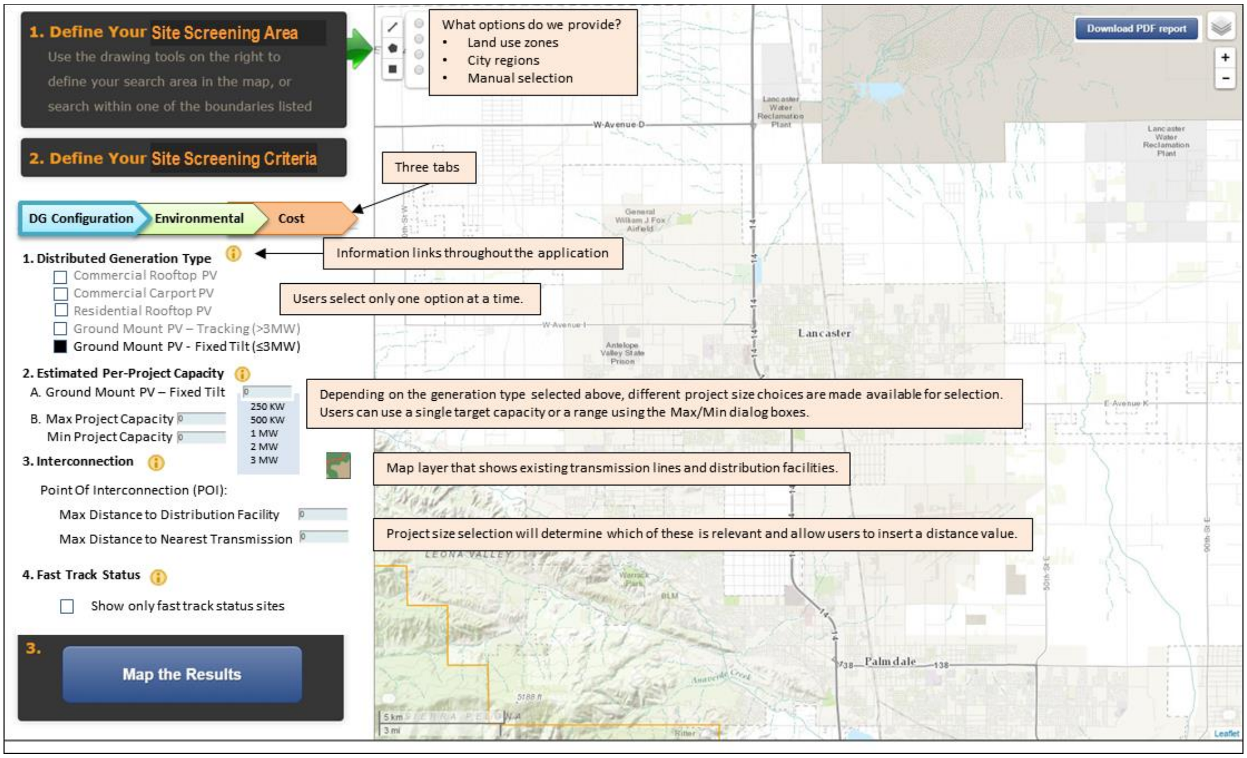


Figure A-8 System Design Tab Screenshot

6.2 Environmental Setting Tab

The environmental setting tab will only be enabled when the user has selected the ground mount DG Type. The user will be able to click through the options demonstrated in Figure A-9 Environmental Tab ScreenshotFigure . Each user setting includes a Map Icon which will allow the user to visualize the data for the selected area in an additional pop up screen when clicked (Figure). The user can also download this data from the Databasin website.

The first selection is to check on or off whether to show environmental exclusions that prohibit PV from being installed. The default will be to have the environmental exclusions not shown, unless the user takes action to check the box. The second check box is an advanced exclusion option that would or would not include conservation priorities in the excluded lands. The default will have this selected, so that parcels with conservation priorities are screened out from possible eligible sites.

Following the check boxes are five slider bars corresponding to the datasets described in Section 5.3 of this appendix. Moving the slider to the left makes each environmental data set more restrictive, and will screen out more parcels from inclusion. Likewise, moving the slider to the right makes each environmental data set less restrictive, and will add more parcels as passing to the next screen. The user will have the ability to slide the bar to adjust the degree of exclusion for each environmental sensitivity, which include:

- Terrestrial intactness
- Conservation value
- Number of covered species
- Wildlife linkage
- ACE II Biorank

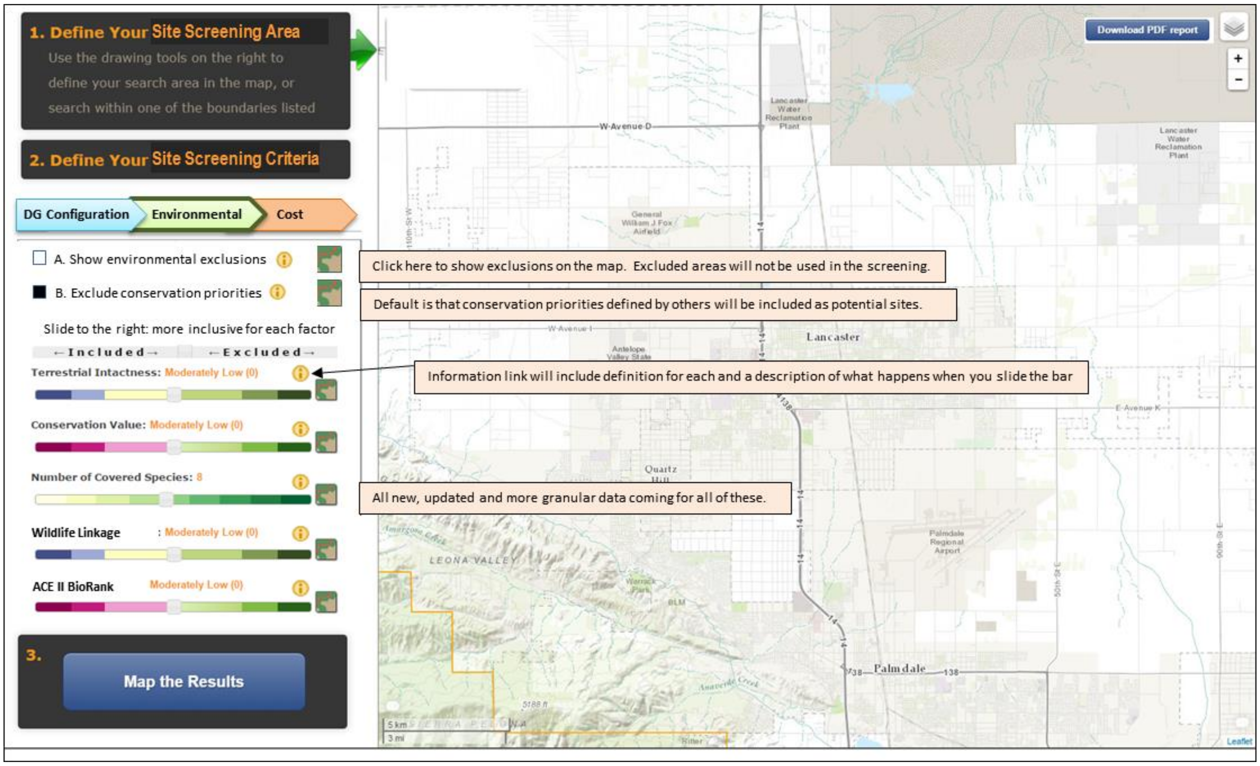


Figure A-9 Environmental Tab Screenshot

Figure shows a mock-up (without real data) of how different parcels would be screened, based on the environmental inputs selected. The number of parcels highlighted with high terrestrial intactness will increase as exclusions are more inclusive, and will decrease as environmental exclusions are more restrictive. The spatial data can be downloaded by clicking on the Data Basin download button, immediately above the key for terrestrial intactness.

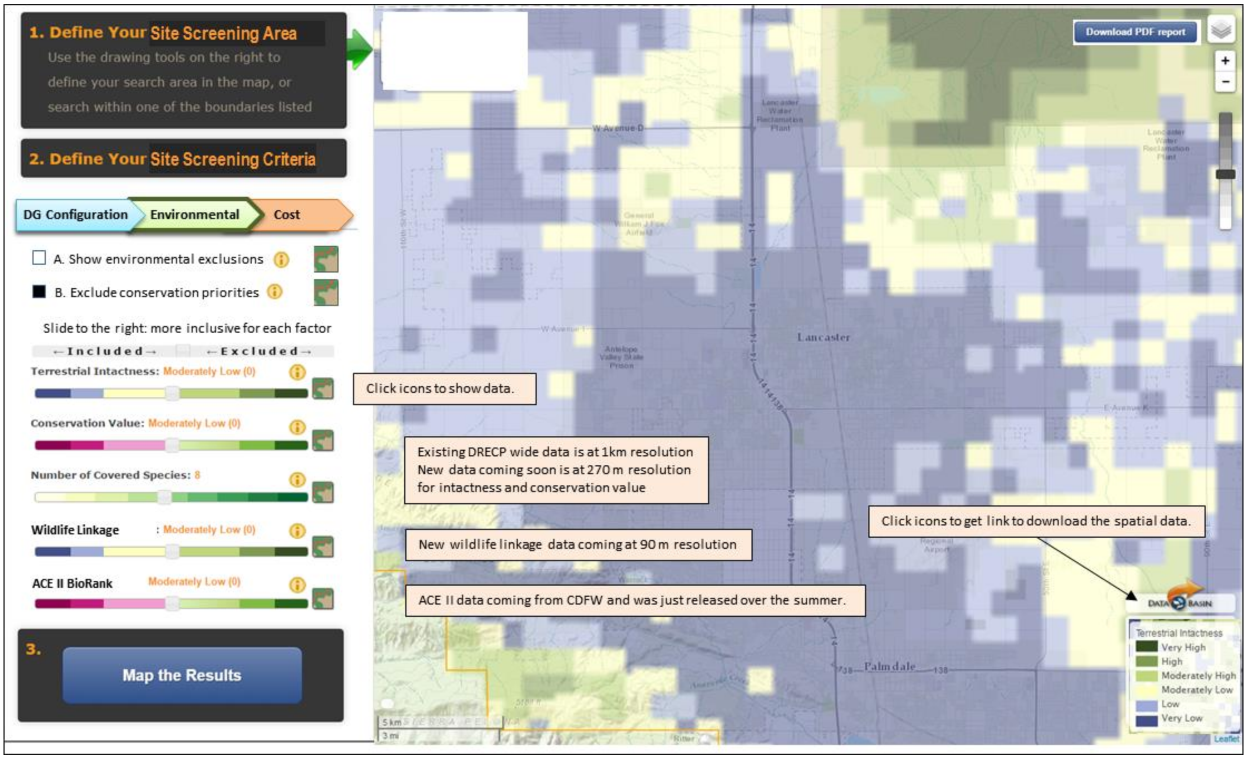


Figure A-10 Environmental Tab Screenshot – Visualizing the Data

6.3 Cost Tab

The final tab will be the cost tab (Figure A-11), which allows the user to select a project owner type, show parcel boundaries, show zoning/land exclusions, the estimated LCOE that results, identify a maximum acceptable LCOE, and view the technology and financing input assumptions.

Eligible project owner types will be determined by the selected DG Type and will determine the project financing assumptions used in the LCOE equation. There are four main project owner types:

- 3rd Party Developer
- Commercial
- Residential
- Government/non-profit

The selection of project owner determines which federal tax incentives are applicable, if any. 3rd party developers, commercial, and residential owners are eligible for the investment tax credit (ITC); 3rd party developers and commercial owners are eligible for modified accelerated cost recovery system (MACRS; aka accelerated depreciation). Government/non-profit owners are not eligible for any federal tax credits. The four project owner types, modified to include tax credits are:

- 3rd Party Developer (ITC, MACRS)
- Commercial (ITC, MACRS)

- Residential (ITC)
- Government/non-profit (none)

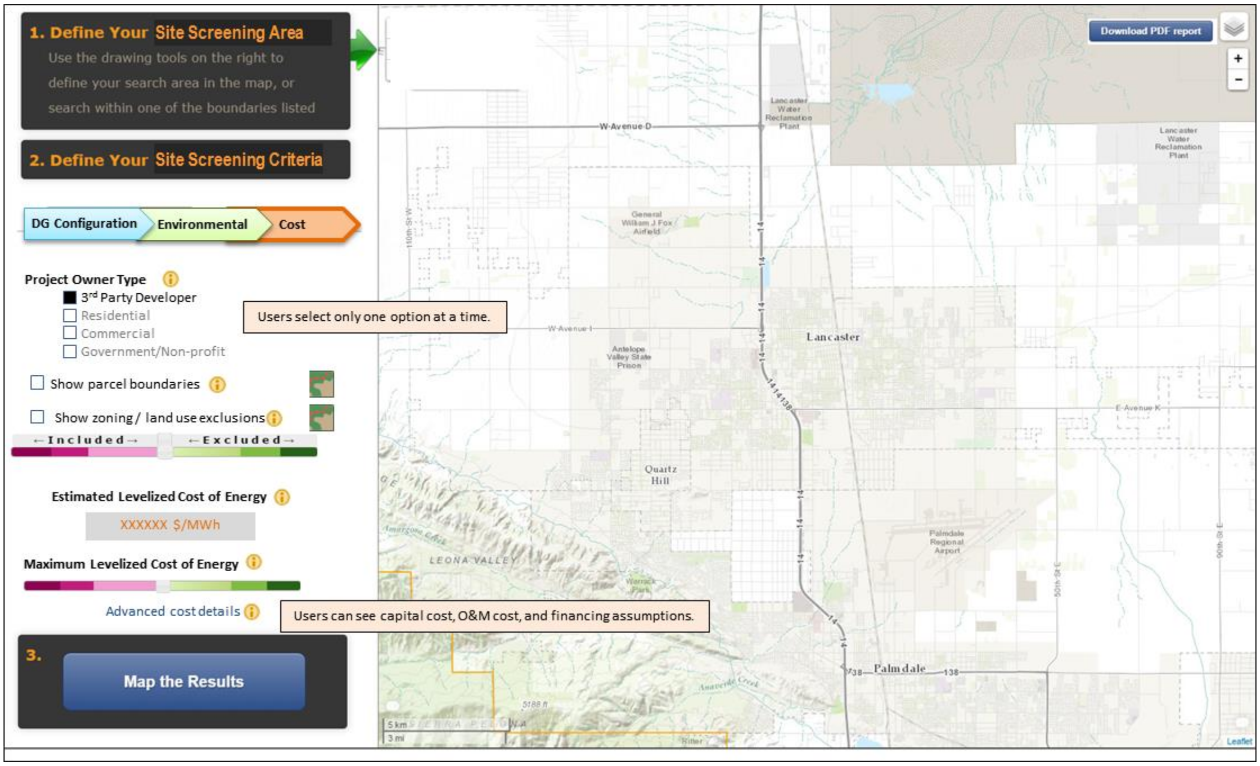


Figure A-11 Cost Tab Screenshot

The user will have the option to show the parcel boundary GIS layer, which will outline each boundary of each parcel. The default will be for this to be turned off.

The application will show which parcel zoning clearly allows solar PV ground mount development, and those that clearly disallow it. Zones that clearly disallow solar PV will not be included in any solution sets; zones that clearly allow solar PV will always be included in the solution set. If there are zones where it is unclear, we may include a slider bar that would allow users to be more or less inclusive of zones that fall in the gray/unclear area (currently shown on. Again, this only applies to ground mount systems.

The estimated LCOE will populate to show the estimated LCOE for solar projects based on the user selections, the default values (if unchanged) or both if a combination was used. This will be populated with the default project configuration when the application is opened and will automatically update as the user changes the selections. Because the 80 cases will be pre-run and populated, the team expects the update of the LCOE after users change inputs to be quick (almost instantaneous). We will have to investigate how quick this can happen for future versions of the model, once the additional functionality envisioned (or some subset) is included.

After the project owner type has been selected, the user can specify a maximum LCOE value and screen projects based on maximum LCOE value. If the slider bar is moved too far, such that no parcels in the search area meet or come in under the maximum LCOE value, an error message will appear, suggesting that the user increase the maximum LCOE value, or select another location.

A final slider will be included that will allow the user to adjust the capital cost expenses up or down relative to the baseline cost curve. The 80 LCOE cases will be pre-run in 10% increments up to plus or minus 50% change in capital cost. The reported LCOE will be based on the user selected capital cost on this slider.

On this tab the user can click on the "advanced cost details" for greater detail on the specific assumptions included in the LCOE calculation for a given project owner type. These project input assumptions will include details, based on the project generation type, estimated project size, and project owner to determine inputs for:

- Capital cost
- Fixed O&M
- Variable O&M
- Degradation
- Discount rate/Rate of return on equity
- Debt Term (years)
- Debt % (total project costs)
- Energy price escalation

A.7 Outputs and Reporting

At any point, on any of the screens, the users may click the "Map the Results" button. The analysis will use default values for any of the tabs or inputs that users have not updated. Users will find a map that best meets their needs if they enter all relevant inputs through all the tabs.

The onscreen map will then generate highlighted parcels that meet the cumulative selected criteria (or default criteria if not selected). This is shown in Figure A-12 below. An ordered list of eligible parcels identified by the APN will be displayed on screen. The list will be ordered from top to bottom in terms of LCOE from lowest (i.e., most economic) to highest (i.e., least economic). Additionally, a white pop up bubble will display showing the overall results within the selected area, including total parcels to pass the screen, and total portfolio capacity (MW).

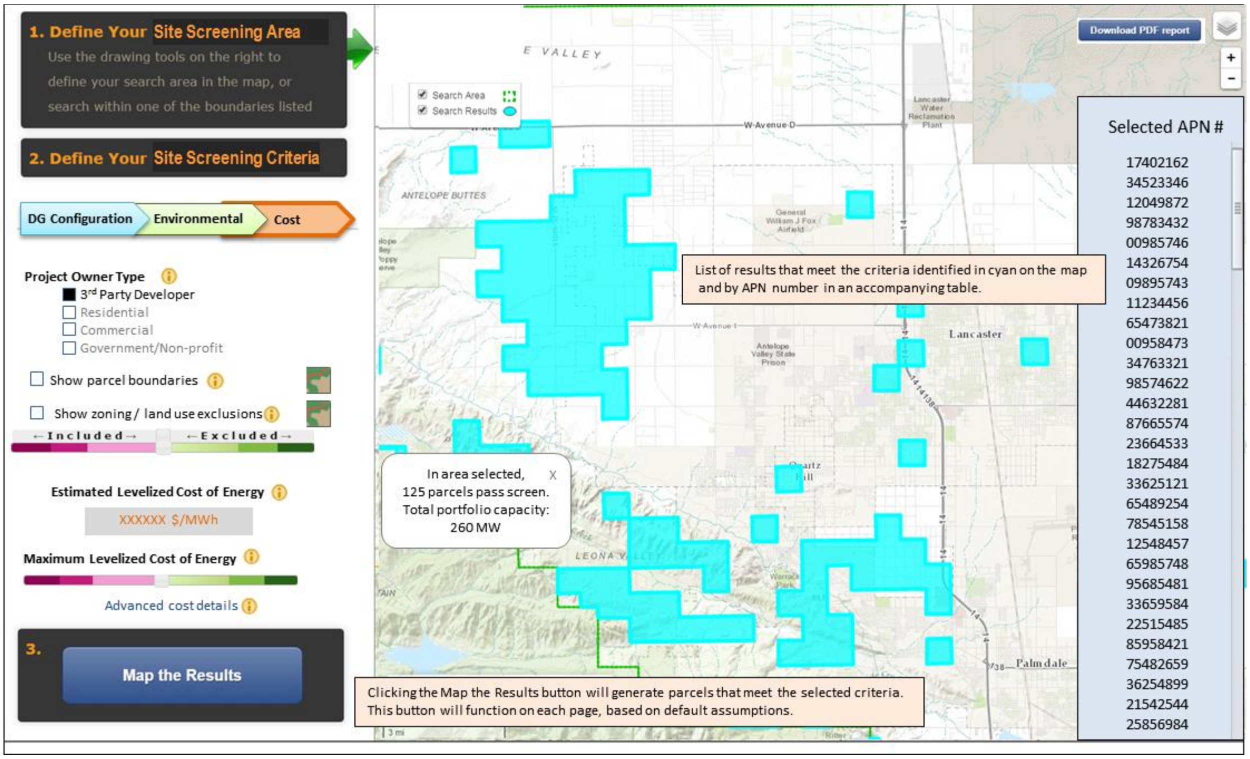


Figure A-12 Map the Results Screenshot

The user can chose to export results into a PDF report, by clicking on the button in the upper right hand corner of the screen. An example is shown in Figure A-13. This will include a summary of all of the user defined inputs, a map of the parcels, a count of the total selected parcels, and portfolio amount in MW. An alert will pop up if the screening criteria do not match any locations.

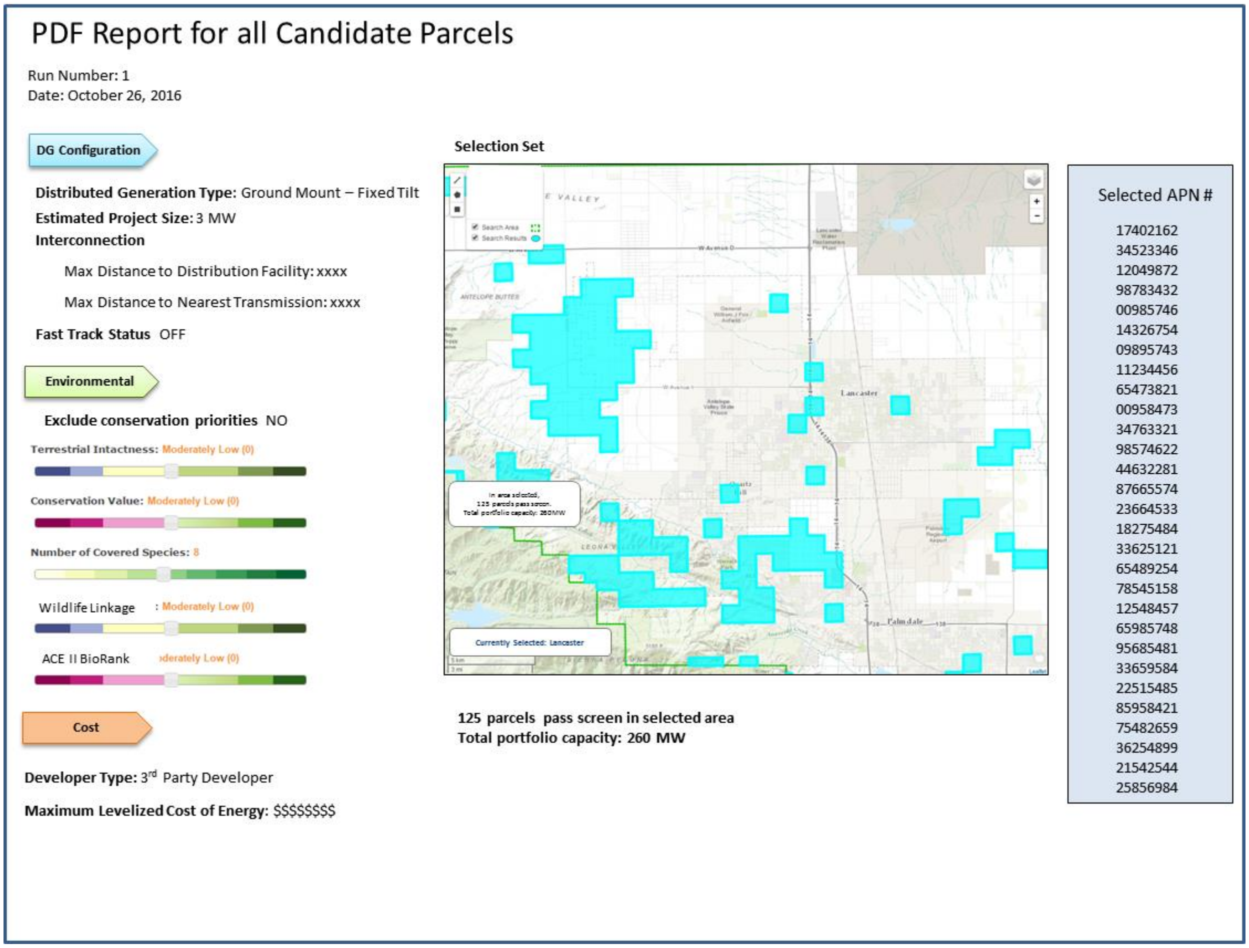


Figure A-13 PDF Report for all Candidate Sites Meeting the Screening Criteria

In later versions of the application, the cyan coloring may be updated to demonstrate the LCOE of a particular project site. This heat map functionality would be most useful under future updates where there is a higher level of variability in LCOE across project sites due to a variety of DG types, capacity factor or location specific costs.

As shown in

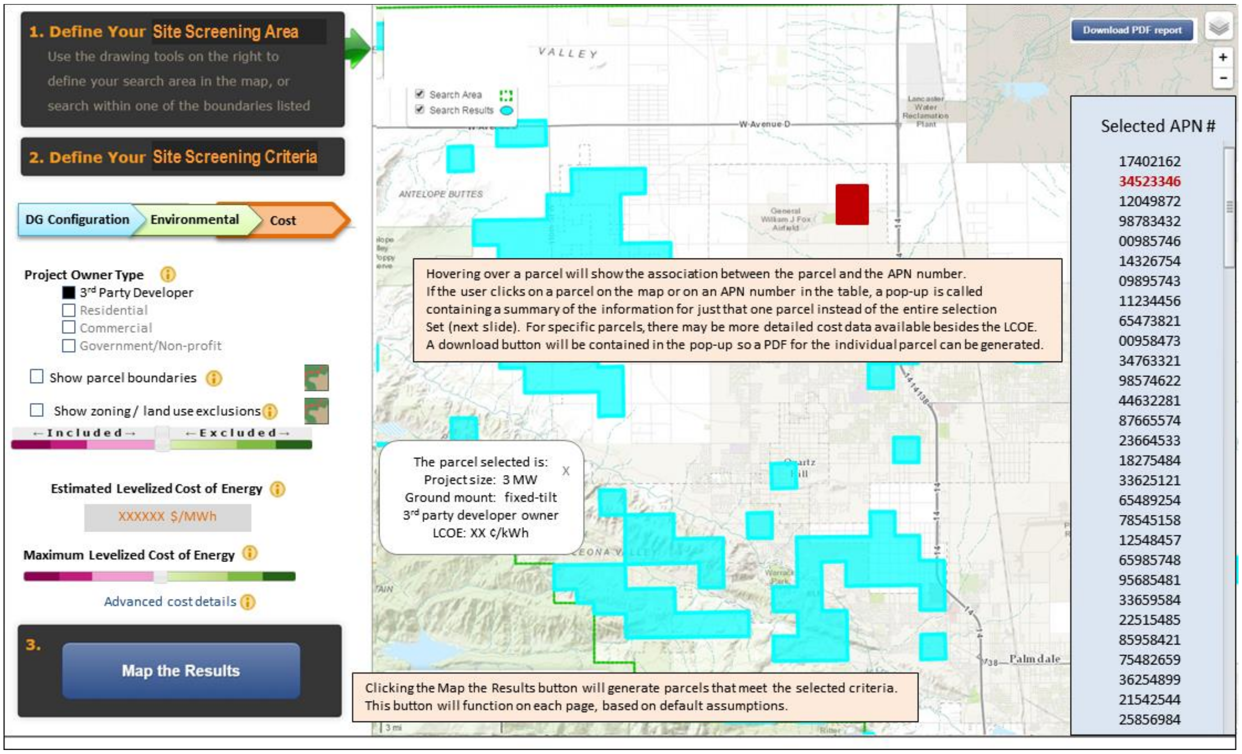


Figure below, if the user were to select an APN from the ordered list, or to click on a particular parcel, the parcel will turn red on the map and the APN number will be highlighted red. The parcel specific information on project size and LCOE would also display on screen. If the user hovers over a parcel, the APN number from the list will be highlighted.

The user can also chose to export results for a single parcel to PDF using the “Download PDF report” button, with detailed information for that project. This will include user inputs, relevant map, and detailed cost and interconnection information, as shown in Figure .

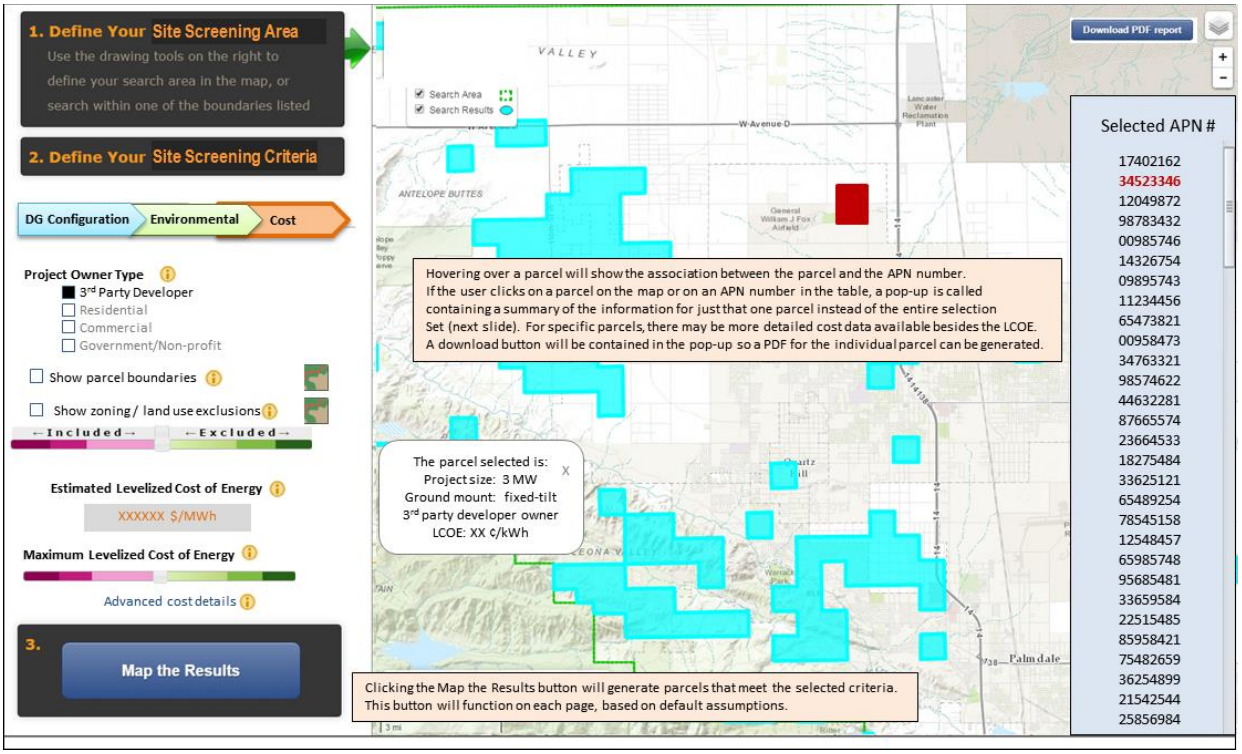
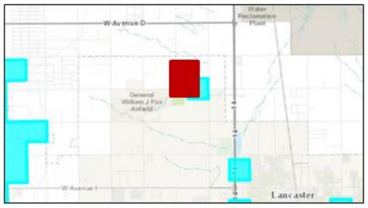


Figure A-14 Map, with Individual Parcel Highlighted

PDF Report for Specific Parcel

APN 34523346



DG Configuration

Distributed Generation Type: Ground Mount – Fixed Tilt

Estimated Project Size: 3 MW

Interconnection

Distance to Distribution Facility: xxxx

Distance to Nearest Transmission: xxxx

Fast Track Status Meets Fast Track criterion

Environmental

Terrestrial Intactness: Very Low

Conservation Value: Low

Number of Covered Species: 4

Wildlife Linkage: No

ACE II Biorank: 2

Cost

Developer Type: 3rd Party Developer

Maximum Levelized Cost of Energy: ¢ / kWh

Detailed LCOE Inputs

	GM – Fixed Tilt
Capital Cost	$ x/kW
Fixed O&M	$ xx/kW-yr
Fixed O&M Escalation	%
Variable O&M	$ xx/MWh
Variable O&M Escalation	%
Degradation	%
Discount Rate	%
Return on Equity	%
Debt Term	<years>
Debt Percentage (vs. Equity)	%
Debt Interest Rate	%
Energy Price Escalation	% / year
Tax Rate	%

Figure A-15 PDF Report for a Specific Parcel

The project team will also explore the possibility to export a .csv spreadsheet containing parcel attributes for each project including, user defined inputs, project capacity, circuit information for the interconnection facility (from SCE DERiM maps) and detailed LCOE cost assumptions.

APPENDIX B: TAC COMMENTS AND RESPONSES

The project team hosted two online TAC meetings. The first meeting was held in Fall 2016 to review the draft technical specification. The second meeting was held in March 2017 to solicit feedback on the beta version of the tool following a live demonstration. This appendix contains tables of the primary comments received from the TAC members along with how the comments were resolved during the project. The resolutions fell into three categories: Include in the current version, Include/Consider in the next version, and Not feasible. This organization of the TAC comments and project team responses helped communicate with the TAC how their advice was being used but also documented ideas for future enhancements.

<u>TAC 1 Meeting Comments - October 26, 2016</u>

Category	Comments	Include in the current version	Include in the next version	Not Feasible	BV/CBI Comments
Audience	The application should clearly define a target audience and cater the application towards this audience. One primary audience identified are developers looking to build DG PV. However, it is unclear if developers are interested in utilizing an application instead of relying on their own data, information and decision-making processes. **Speaking more directly with developers could help inform the usefulness of the tool to developers.** Another primary target audience are local planners. An application for local planners might have different functionality than one for developers – **the application should be built specifically for evaluating project applications.** From an environmental and land use perspective, this tool has the potential to be informative in the review of DG project applications, **if the environmental data is accurate and available at an appropriate resolution.** If the target audience are home-owners, or commercial owners, **then the transmission end is not necessary, and care should be taken to not duplicate the LA Solar Map** that tells owners where to put panels and how much money they generate.		X		Where possible the project team will try and enhance developer involvement for future recommendations. Perhaps a "developer" demo can be arranged with the beta version outside of the TAC for comments and recommendations on next steps. The tool is not designed to evaluate project environmental applications, this could be considered in the future. The transmission component is only for ground mount type larger DG systems. The tool included DERiM info which is not incorporated in the LA Solar Map.
Beta Testing	Will there be an opportunity during beta testing to use the tool in other places of California to better understand if the final steps to develop the tool will allow interoperability across California?			X	This can not be accommodated during Beta test because some of the datasets used are location specific. Not all areas of CA have Rooftop and Parking Lot data available or the DRECP specific environmental analysis. It may be worthwhile to perform a review of availability of these types of datasets statewide to provide recommendations for next steps. In the future, there may be possiblity.
Environmental Data	The environmental datasets were produced for an area greater than 20 million acres in size (the DRECP area) and Lancaster is a significantly smaller area, thus the resolution of the environmental datasets is not appropriate for a study area the size of Lancaster. The resolution must be better, as DG PV projects are very small in size. We would recommend a dataset related to land disturbance, as this would be a good proxy for habitat value and connectivity.	X			Updates to 270m resolution will be included in the current version. New datasets will not be developed as part of the application, but improvements may occur in future versions.
Environmental Data	If and when it's applicable, the tool should distinguish between Draft 2014 DRECP EIR/EIS data and the final DRECP LUPA data.	X			
Environmental Data	Additional data that should be considered: - **California Department of Fish and Wildlife vegetation mapping**: detailed vegetation mapping for the West Mojave that was ground-trothed. In this dataset, there is a "disturbance" attribute that ranked the polygons according to the level of land disturbance. This dataset can be downloaded from Databasin: https://drecp.databasin.org/maps/4f8006c5f03141a185057b5958289552/active; - **TNC West Mojave Assessment:** This assessment was based on a white paper titled: "Renewable Siting Criteria for California Desert Conservation Area" written jointly by multiple environmental groups. TNC identified areas that are high conflict and areas that may enable least conflict siting of solar energy, based on the criteria outlined in the white paper. More information can be found here: https://drecp.databasin.org/datasets/2c304ce76515495c890e816a9e6d3199; **- existing and planned infrastructure** (rail, highway, housing, energy, etc.); **- avoidance areas due to environmental sensitivity** (e.g. SEAs); **- cost of mitigation in different areas** – consult the City of Lancaster to see if they have a system for identifying mitigation cost depending on location.	Vegetation Map is Included;		Cost of Mitigation, Renewable Siting Criteria for California Desert Conservation Area, Existing and Planned Infrastructure	The latest vegetation mapping data is included in the conservation values modeling via the statewide energy project. The TNC West Mojave Assessment will be a filter user can choose to include. Existing and planned infrastructure is difficult to get permission to use. Will have to pass on this pilot. Latest SEAs are being included although very little of this area falls within city limits. Cost of Mitigation is not feasible at this time because there is no stable foundation upon which to evaluate it.

Category	***Comments***	***Include in the current version***	***Include in the next version***	***Not Feasible***	***BV/CBI Comments***
Environmental Data	Will the tool allow users to add their own layers of environmental information? Such as local conservation easements and open space designations? Possible for zoning?			X	The programming for this is too complex to achieve under current scope. This will be considered for future applications
Environmental Data	the EPA Re-Powering America program estimates renewable energy potential from contaminated lands, landfills, and mine sites. I can think of a couple of ways that this might be useful in your project. First, it could provide an independent estimate of PV potential for comparison with your own estimates. Second, it could be a filter to screen for those sites as a scenario or at least to give preference to them.		X		CBI looked into the available spatial data on this comment. There are several points in the surrounding area though, so if we do expand the tool to cover a larger spatial extent, this may prove quite useful. The KMZ's can be converted to GIS formats, but I'm not seeing that any of the points in those files fall within the city limits.
Environmental Data	Is there a way to rank rooftop and parking lot DG PV solar as highest from an environmental perspective? From a land use/environmental perspective, DG on rooftops and parking lots is a more efficient use of space, minimizes impacts to the land and has no additional impact to wildlife and plants. It would be great if this application could account for this lack of environmental impact in some way.			X	The tool is designed as a screening tool and not ranking. Ranking will be related to risk appetite of the developer. Currently the user can only evaluate one DG type at a time. Ground Mount is not compared directly to RT/PL.
Interconnection	Include a note that the 15% Screen is an eligibility requirement but does not guarantee that the project is Fast Track eligible.	X			This was echoed in comments from the as well as follow up discussion with
Interconnection	SCE recommended to include reference to Rule 21 per unit cost data.	X			B&V will evaluate if per unit cost data should be included in interconnection cost calculation. Either way the tool will include a link to the more detailed per unit data as a reference for developers.
Interconnection	Inclusion of interconnection facility costs. This could be either an estimate or range. Currently using distance as a proxy for cost.		X		B&V spoke with in a follow up conversation and was advised that public costs for distribution upgrades have been released. At this time, due to the calcuation method of LCOE and the uncertainty concerning the value of applying "standard" assumptions for gen tie costs, distance will remain a proxy for cost. A link will be provided to the SCE Distribution Per Unit Costs for developers to use in detailed cost estimation.
Interconnection	Developing spatial approaches to including the next best point of interconnection.		X		This was echoed in , asked if there was any optimization that may be added such as finding the closes interconnection location or a ranking of interconnection costs. BV/CBI believe that due to the format as a screening tool, this will not be accomplished under current scope.
Land Exclusions	Add a drop down to allow users to select suitable slope for projects (From 30 or 90 m DEM models).	X			May not have a large impact on Lancaster, but will be included incase of future projects. Will be done at 270 meter.
Land Exclusions	Ensure that we have included the latest easement layer. Confirm with TNC/Lancaster/CEC	X			CBI will use the current layer that they have, there is nothing new.
Location Selection	Query tool for an individual land owner that allows one to display attribute info for a selected parcel. For example, relevant environmental information, power generation capacity, etc.	X			When you click it will just tell you basic information about the place. **These would be the static fields only, nothing dynamic.** Users are making certain assumptions as you proceed through the screen.
Location Selection	It is useful to have the outputs be based on a user-defined **blended portfolio**. The user should be able to select environmental variables, cost and types of projects and see where **optimal** projects can be sited.		X		The tool will not be designed under current scope to optimize, this is addressed in previous comments. The tool will only be one type of DG, thus not a blended portfolio. All other items are addressed in the current form of the tool.
Reporting	Alerts when screening criteria do not match any location	X			

Category	*Comments*	*Include in the current version*	*Include in the next version*	*Not Feasible*	*BV/CBI Comments*
Reporting	Include the number of parcels included in the portfolio summary and include the parcel borders.	X			
Reporting	Introduce color scheme to distinguish LCOE on final pixels parcels selected to discriminate based on costs of installations		X		For the City of Lancaster the LCOE will be similar for all projects shown. The only variation will be when the user inputs a range of project sizes. This may change if we include interconnection costs. For the current version, may not be the most useful, but will explore further if there is time.
Reporting	For distance to closest interconnection facility, it might be more useful to show users the nearest facilities (e.g. rank the three closest) because it's possible that interconnection slightly further from the closest facility is more optimal from a cost perspective.		X		We will consider reporting this information in future versions if interconnection costs are added in.
Reporting	It would be helpful to include available capacity on distribution lines or at distribution centers.	X			Use symbolization to show feeders a certain color. The SCE DeRIM Map Link will be provided.
Reporting	Add the ability to click on a specific parcel to see estimated project costs associated with different energy generation types.		X		This may not fit with the current screening functionality of the application.
Solar PV	Per acre development assumptions are very different for the different types/configurations that drive land requirements- suggest working with SEPA and the developers as well as the city/county reviewing development applications for appropriate ranges for tracking and fixed tilt.	X			BV intends to provide these assumptions based on project experience through work with developers. Time depending, these values may be further refined by outreach with SEPA/developers.
Solar PV Data	The first round of solar data for rooftops was derived from 2006 elevation raster dataset. The eGIS Group has calculated incoming solar radiation for parking lots over 5,000 sq. ft. on industrial, commercial, government, institutional, and recreational properties located in Los Angeles County. This dataset can be provided, upon approval by County Office of Sustainability, after the launch of the new solar map application.	X			BV requested on 11/11 for LA confirmation that this is approval to use dataset.
Solar PV Data	Credit for any solar data or source of solar data should be given to County Office of Sustainability and the ISD eGIS Group. The second round of solar data analysis for rooftops and parking lots will be performed around mid-2017. The dataset was captured 2015/16.	X			
Zoning	Include latest Zoning Data (Lancaster: RR2.5 or Heavy Industrial Zones, LA County:?) Zoning information can be downloaded as GIS shapefiles by searching here: http://egis3.lacounty.gov/dataportal/. County also provided this data to CEC previously, in connection with the DRECP, and it is still valid. [LA Written Comment]	X			Additional written comment from LA: For example in unincorporated LA County, ground-mounted, utility-scale solar facilities are prohibited in Significant Ecological Areas (SEAs) and Economic Opportunity Areas (EOAs), and otherwise permitted with a Conditional Use Permit in certain zones only (A-2, C- and M- zones). Note that the above prohibitions do not apply to "small-scale" solar/wind projects, as defined by the Renewable Energy Ordinance (energy generated "primarily for on-site use")
Zoning	Office of the Assessor has collected 2013 zoning data (shapefiles) for roughly 56 cities in Los Angeles County. The shapefiles were provided by the cities to the Assessor in exchange for their property data. We're not sure if we are allowed to distribute the zoning data but thinking it would be made available, since the datasets are a few years old.	X			B&V has requested this from LA County. LA indicated. The Office of the Assessor suggested asking the city planning department offices about use limitation and/or see if they can provide more recent data. BV also reaching out to Lancaster for GIS version of this document to compare: http://www.cityoflancasterca.org/home/showdocument?id=12653
zzComment	Stakeholders emphasized the importance of updating the data in the tool. The environmental datasets are compilations of multiple datasets so it would be helpful for environmental groups to be able to see the data inputs into each model and how they were combined to produce terrestrial intactness, conservation value and wildlife linkages.				
zzComment	Stakeholders emphasized the usefulness of being able to see the links to Databasin for each of the data sources. They also emphasized the speed of the tool being an important feature.				

zzComment	There was a question about the assumption used for acre/MW conversion. The logic flowchart should be updated to include assumptions like these as they are built in the tool.				This will also be shared in the Info buttons.
zzComment	As feasible, the tool should be interoperable with all areas of California and not necessarily designed around the available data structure from Lancaster. RPS Calculator has renewable resource values, Version 6.3 should be available soon.				Where RPS inputs are used, B&V is using resource numbers that will be incorporated in the V6.3 update. Statewide datasets are sought, but many, such as the Rooftop/Parking Lot analysis, has not been performed statewide. As statewide data becomes more available, these should be incorporated in the tool.
zzComment	At a high level, the tool does seem like it will be useful, especially if the tool is capable of working in all areas of California.				
zzComment	1. How about the SOI surrounding Lancaster and LA County land use? 2. How do the B&V cost curves compare to the RPS Calculator curves and do they apply statewide? 3. Will the tool be able to use additional data and information being developed in the IOU DRPs? Such as the LNBA methodologies that may apply to the ICA? 4. All data being used in the tool should be publically available and protocols for accessing data should be replicable where ever the tool is used. 5. Will the tool give a LCOE as output that can be manipulated? Such as, being able to change financing assumptions? 6. Is it possible to produce a "portfolio" report that describes a group of APNs?				1. Species of Interest data will be included in the search criteria within the city limits. 2. Cost curves are the same as RPS Calculator Curves V6.3 [current September 2016]. These will be refined and updated based on any latest trends. It is assumed that they apply statewide. Currently financing assumptions can not be changed due to the complexity and computation time to calculate new financing assumptions on the fly. The project team will attempt to include an adjustment percentage based on user input to account for rapidly decreasing solar costs. 3. This would be ideal. We are considering including per unit costs recently published under Rule 21. Any LNBA/ICA integration would be under future scope. The current plan is to use the 15 Percent Fast Track Screen from the RAM map. 4. There will be links to databasin for the sources and inputs used. 5. There will be preloaded financing assumptions for each ownership type. The user will not be able to adjust assumptions, maybe in the future. 6. Yes, this is included.
zzComment	One aspect of this tool that should be revisited is the inclusion of ground mount facilities with rooftop installations. They are very different types of infrastructure with different environmental and planning implications. If the application were only for rooftop installations, then there is no need for any of the environmental data.				Agree that these are very different types of infrastructure. Currently the tool attempts to accommodate either type of DG to be evaluated. The tool does not bring in environmental considerations for rooftop installations, but allows these considerations to be made if the user is interested in ground mount. This allows for maximum flexibility.

TAC 2 Meeting Comments: March 16, 2017

Category	*Comments*	*Include in the current version*	*Consider in the next version*	*Not Feasible*	*BV/CBI Comments*
DG Type	For our purpose, I am not sure that the breakdown between fixed and tracking is useful since we use primarily tracking even for the smaller sizes.		X		Will consider this for updates in the next version and if there can be user adjustment built around mounting structure.
Parcel	Recommend consideration of the connectivity of parcels and selecting project sites that are more than one parcel.			X	Currently the tool is set up to screen at the parcel level. Introducing parcel connectivity would fundamentally change the functionality of the tool, this is something that could be considered under future major changes to the tool.
Help	Can kW/acre be added to the help file?	X			Yes -- this will be added.
Reporting	Can this be hosted on Data Basin and will users be able to save and return to searches and results.		X		This could be considered for inclusion in the next version. For the pilot focus was on developing a working tool and the application is not currently apart of the Data Basin platform.
Interconnectio	Is there going to be a visual representation of congestion on the line?		X		Visual indicators of available capacity is shown on the DERIM maps, it could be considered to bring this into the tool. Real time congestion maps are dependent on the markets and not available to public. As the DRP Integration Capacity Analysis and Locational Net Benefit information is finalized and added into DERIM, there may be additional information that can be brought in at the POI beyond Fast Track Screen. This will be over the next years.
DG Type	Consider allowing the user to select project size in terms of acres instead of MW.		X		
Environmental	On focal species, could we exclude parcels with actual occurrences/ sightings, not just potential based on model estimates.		X		This may not be feasible due to data privacy, but could be considered and looked into more in the future.
Environmental	Include additional environmental layers: NWI, cultural resource layers, slow, known endangered species occurrence, soil.	X	X		Will include the NWI layer, others could be added in the future depending on data availability. Would need to consider geographic scale at which these layers are useful (e.g. slope)
Reporting	When expanding the area of the tool, you may not need all filters at all resolutions. Refining filter resoltuion to match area will be helpful.		X		
Error	When using IE there is no screen report and no PDF creted.	X			Place message on the intro page "IE is not supported" . Use the logo for IE.
Map	I found myself wanting to zoom back out from the selected parcel to either the previous map extent or to the study area. I did not seem an icon to do that, only to zoom out incrementally.	X			Add a button to the map to zoom to the study area or the full extent if there is no study area.
Map	I hit the maximum zoom limit and still wanted to zoom in closer to parcels/rooftops. I assume it was a conscious decision about where to set that max zoom limit.	X			Set at 16x as the parcel data limits the zooming extent. We will set it to we can zoom in >16x but a message will pop up that lest the user know that the parcel boundaries can be viewed only lower zoom level.
Map	It would be cool to show maps comparing results from the energy screens vs. environmental vs. cost. In other words, how each subsequent group of screens reduces the selected set of parcels. This would be a different kind of report, probably more of interest to planners, but useful to show the “cost” of each constraint. This could also be done as a single map showing Energy parcels in blue, Environmental (after Energy) in green, and Cost (after the other two) in red (or any color combination). Perhaps it could also report the average		X		
Cost	Why is the max LCOE set to 7.2 cents initially? What is the basis for this? Can this be included in the help files.	X			The LCOE values will change dynamically to capture all LCOE values based on user inputs. The initial setting will be set all the way to the right.
Cost	Need to indicate the assumptions that are included in the LCOE calculation.	X			These have been added to the tool.

Category	*Comments*	*Include in the current version*	*Consider in the next version*	*Not Feasible*	*BV/CBI Comments*
Cost	Capital Cost, we need to report the 100% values so that people have a reference for what this is based on.	X			Mean Total CAPEX is now reported.
Cost	Financing is there any way that we can show the financing options PPA/FIT/NEM etc? This is included in SAM.		X		This will be considered in the next iteration if we are able to link to SAM in real time. At present, revenue sources are not included.
Cost	Note that we used SAM to calculate the LCOE since this lends credibility to our tool.	X			Added to help.
General	may be interested in the CBI Environmental layers for the LA County Solar application update that will be released this summer.				These layers should be on Data Basin so she should have access to them.
Zoning	County has information on zoning and resource planning and endangered species.		X		Spoke with Tiffany who was supportive, but was not able to receive the layers in time.
Results	I go to try the tool , I get an error message when I click map my results. It does not seem to matter what criteria I utilize.		X		Unclear about of the nature of this issue. Reached out to Jocelyn, but did not hear back.
Results	when I reviewed the power point presentation, some the information appeared to be incorrect. Specifically, it identified a parcel as government/nonprofit which happens to owned by a private developer and was permitted for solar in 2015 as part of a much larger project.		X		We are not screening parcels based on ownership type, i.e. government/non-profit. Ownership selection is currently for the LCOE calc. The only zoning-type screens are based on DG Type so we filter out zones that fit residential/commercial/ and ground mount. This could be interesting to consider in the future and would need to know where ownership information could be obtained.